



**US Army Corps  
of Engineers**  
Omaha District

Revised to  
Garrison

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# **MISSOURI RIVER GAVINS POINT DAM**

## **DEGRADATION TRENDS STUDY**

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## MISSOURI RIVER - GAVINS POINT DAM

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## CHAPTER I - INTRODUCTION

### PURPOSE

This report evaluates degradation trends of a study reach downstream of Gavins Point Dam. Basic pertinent data collected on various hydraulic and geomorphic elements and channel characteristics collected after the construction of the Gavins Point Dam are presented and evaluated. This volume will serve as a permanent record of most of the basic observations.

### SCOPE

The study reach extends from Gavins Point Dam (1960 RM 811.01) downstream to Ponca State Park, Nebraska (1960 RM 753.18), a total distance of 57.83 miles. All river miles are 1960 river miles unless otherwise stated.

This report examines pertinent data which includes water surface profiles, stage-discharge curves, channel cross-section, channel geometry, sediment bed material, and streambank erosion rate. Extensive data were collected specifically at years 1956, 1965, 1986 and 1994 for degradation evaluation.

This publication contains basic field data collected by the Corps of Engineers from 1955 to present.

The format will assemble historical physical channel data and background information in the form of discussions, tables, and plots to identify the presence of any significant trends in the change of the geomorphic character of the river study reach which have an impact on channel degradation.

## CHAPTER II - GENERAL INFORMATION AND PERTINENT PROJECT DATA

### GAVINS POINT DAM AND DRAINAGE BASIN

Authorization. The Gavins Point Dam and Reservoir was authorized by the Flood Control Act approved 22 December 1944 (Public Law 534, 78th Congress, 2nd Session) as part of the general comprehensive plan for flood control and other purposes in the Missouri River Basin.

Purpose. The dam is a unit of the plan for development of the Missouri River Basin. The project, in coordination with other projects in the system, provides protection for downstream areas from damage by floods originating above the project, assures an adequate supply of water for navigation, irrigation, stream sanitation and municipal use, and generates electrical power. More specifically, the Gavins Point Project operates as a re-regulating dam to smooth out the wide range of releases resulting from power generation at Fort Randall Dam.

General Description. The Gavins Point (Lewis and Clark Lake) project is one of the smaller units in the Missouri River mainstem system of six multiple-purpose dams. A summary of engineering data for the Missouri River Mainstem Reservoirs is given in Plate II-1. The dam is located in the states of Nebraska and South Dakota, approximately 4 miles west of Yankton, South Dakota. It is 811.05 (1960 mileage) miles above the mouth of the Missouri River. The project was initiated in 1952, closure was made in July 1955, and power generation began in September 1956. The Lake extends about 35 miles upstream from the dam, covers 31,000 acres, and stores 492,000 acre-feet of water at the maximum operating pool level at elevation 1,210 feet m.s.l. Approximately 165,000 acre-feet of storage capacity has been set aside to contain any floods originating in the 16,000 square mile drainage area between Gavins Point and Fort Randall Dams. One of the major functions of the project is to smooth out the intermittent surges of water released upstream at Fort Randall Dam during peak periods of power generation, thereby enabling the Fort Randall project to operate at full generating capacity.

Dam Embankment and Spillway. The dam embankment is a rolled earthfill structure 8,700 feet in length extending from the left bank of the Missouri River Valley to the spillway and powerhouse structures located on the right bank of the valley. The embankment contains about 7 million cubic yards of fill consisting largely of compacted and uncompacted chalk obtained from excavations for the spillway, powerhouse, and downstream discharge channels.

The crest of the embankment is at elevation 1,234 feet m.s.l., representing a maximum height above streambeds of 74 feet and an average height of about 60 feet above the valley floor.

The spillway is located on the right bank between the embankment and the power house. Since no outlet works were constructed at this project, all releases in excess of power plant discharge capabilities must be made through the spillway structure. The design spillway discharge is 584,000 cfs.

Geomorphological Characteristics. This reach of the Missouri River forms the border between the Western Lakes Section and the Dissected Till Plains Section of the Central Lowland Physiographic Province. The present course of the Missouri River was developed in recent geologic time. This course represents the river's adjustment to flow along the edge of one of the advances of the Wisconsin ice sheet. The present course of the river coincides with the farthest southward advance of the Wisconsin ice sheet and forms the dividing line between the two physiographic sections.

Geographical Setting. The dam is located in the states of Nebraska and South Dakota, approximately 4 miles west of Yankton, South Dakota. It is 811.05 miles (1960 river mileage) above the mouth of the Missouri River. One side of the dam is in Yankton County, South Dakota, and the other side is at the junction of Cedar and Knox Counties, Nebraska. A map of the area is included on Plate II-2. The total Missouri River basin drainage area is 529,350 square miles. The total area upstream of Gavins Point Dam is 279,480 square miles.

Topography. The Missouri River drainage area between Gavins Point Dam and Ponca forms a portion of the Great Plains province of the United States. The area to the north and east of the river is within the Glaciated Missouri Plateau, consisting of gently rolling topography in which stream dissection and drainage are not well established except in areas immediately adjacent to the river.

Drainage in upland areas is largely into pot holes, small intermittent lakes and a few larger permanent lakes. Most of the incremental drainage area lies to the south and west of the Missouri River within the high plains region and is characterized by rolling tablelands with hilly to rough broken areas long the sides of stream valleys. Stream dissection is well-established with broad smooth divides between the large drainages. Portions of the northern Nebraska sandhills are also contained within the Fort Randall-Gavins Point Drainage.

The James River is the first major tributary entering the Missouri below Gavins Point Dam. It enters the Missouri River below Yankton, South Dakota, drains an area of 22,000 square miles and is characterized as being extremely sluggish. As a consequence, flows experienced from this tributary, although usually not large, can be utilized to a great extent in scheduling Gavins Point releases to meet downstream flow targets.

The Vermillion River is a smaller tributary, about 80 miles long with a drainage area above Wakonda, South Dakota of 1,680 sq. mi. Flows from this tributary are usually not considered in scheduling releases.

Geology. The rock strata along this reach area essentially flat, with exposed formations being cretaceous sedimentary beds which dip gently towards the west. Five rock formations are exposed between Gavins Point Dam and Ponca, Nebraska. The stratigraphic sequence in ascending order is the Dakota, Graneros, Greenhorn, Carlile, and Niobrara Formations.

Climatology. The incremental portion of the Missouri Basin discussed in this report is

located near the geographical center of the North American continent. The region lies near the center of the belt of westerly winds; however, the Rocky Mountains to the west form a barrier to a Pacific moisture source. Consequently, the climate of the region is generally classified as continental semi-arid.

Annual average precipitation over the Fort Randall-Gavins Point drainage area ranges from about 14 inches per year in the headwaters of the tributary Niobrara River to almost 25 inches per year in the vicinity of Yankton, South Dakota. Wide variations from the average amounts may be experienced in any year.

Temperatures range from over 100 degrees Fahrenheit at some time during the summer months to 20 degrees below zero or colder during the midwinter period. Winters are long and cold; but are occasionally interrupted by short periods of milder weather. Moderate temperatures usually prevail during the non-winter season.

Runoff. The primary source of runoff from the region near the Gavins Point project is snowmelt. However, on occasion rainfall during May and June has resulted in substantial runoff amounts from the area between Fort Randall Dam and Sioux City. Runoff is extremely variable from year to year. Normal annual runoff from the general area ranges from less than one inch over most of the tributary James River Basin to almost three inches over areas of northeastern Nebraska and northwestern Iowa.

## MISSOURI RIVER STUDY REACH - IMMEDIATELY BELOW GAVINS POINT DAM

General. The study reach encompasses the 58-mile uncontrolled reach of the Missouri River between Gavins Point Dam (RM 811.05) and Ponca State Park, Nebraska (RM 753.18). The study reach and the degradation ranges are shown on Plate II-3. In this plate, 1941 River Miles are used. A conversion table given between 1941 RM and 1960 RM is shown in Table III-1 and Table VI-1.

The climatology characteristics for the study reach are similar to that described for the basin area above Gavins Point.

There are two major tributaries entering the study reach, the James River and the Vermillion River. The James River is about 400 miles long and has a drainage area of 22,000 sq. miles above the James River gage near Scotland, South Dakota. The confluence is at the 1960 RM 797.5 at the left bank. The Vermillion River is a smaller tributary, about 80 miles long with a drainage area above Wakonda, South Dakota of 1,680 sq. mi. The confluence is at the 1960 RM 772 at the left bank.

Study Reach Streamflow Data. The streamflow data presented is for the period from 1955-1988. The two U.S.G.S. gaging stations are the Missouri River at Yankton (Gaging Station Number 06467500) at RM 805.80 and at Gayville (Gaging Station Number 6478515) at RM 796.0. The two other gaging stations are at Maskell (RM 775.8) and Ponca (RM 751.0). Data at these gaging stations were collected by the U.S. Army Corps of Engineers.

Inflow and outflow data for Gavins Point Dam are shown in Tables II-1 and II-2, respectively. The data was taken from U.S. Army Corps of Engineers records dated 1967 to 1995.

The U.S.G.S. collects and publishes streamflow data at stations on the James River near Scotland and the Vermillion River near Wakonda. Tributary flow from these two streams into the Missouri River is generally not significant.

**TABLE II-1**  
**GAVINS POINT DAM**  
**MONTHLY INFLOW (C.F.S.)**

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1967						23700	30400	34000	33800	32900	28700	16000
1968	15600	15600	23400	33100	32700	33600	35700	34000	31000	30700	31100	17200
1969	16600	15700	17900	24900	33700	34300	34800	51900	51600	45200	39600	20200
1970	16800	17100	23400	29600	30500	35400	40900	43800	40800	41300	39300	19500
1971	16000	16700	25000	34300	43700	47500	46500	46700	47400	48200	50200	25300
1972	20200	18600	26500	40000	37300	40600	44000	46100	47000	48300	44500	21800
1973	20300	18900	19600	23100	28000	28700	31600	31800	30900	26200	27600	17100
1974	17000	16800	22500	29600	30200	30300	35300	34400	34800	35000	30000	17200
1975	17200	15600	19600	28300	31900	37800	53900	60400	60900	61300	60900	27300
1976	21500	21600	31300	34900	35100	37700	37800	37300	37500	35400	34800	22900
1977	18700	14900	21300	30100	31500	32600	33600	33100	31900	30900	27400	14600
1978	15100	14300	18000	22000	28000	38600	44900	50300	50300	51800	51800	25800
1979	20800	21300	15000	27900	37000	38900	36100	33900	34900	36400	33600	24100
1980	18800	15200	20500	28700	30400	29300	34200	35500	34500	35000	33600	16000
1981	13600	12900	22400	33200	32600	31600	33400	31700	33500	33600	18700	14100
1982	14600	13100	17800	28600	29000	26600	30500	31500	32000	34200	39000	26100
1983	24100	21800	21500	16300	24600	21400	27700	34900	35000	35200	35100	23400
1984	18800	17500	22000	15800	19800	17000	36200	43300	42800	41900	42900	24300
1985	20200	18500	19800	23000	27400	30800	32400	31200	29300	28900	30900	18700
1986	16100	16100	17700	17500	29200	35200	35700	37300	35800	39500	41200	33600
1987	25800	21900	22900	27600	28600	29600	30200	31000	30800	31800	31500	18000
1988	18000	17100	22500	29700	31100	32300	32800	32400	35400	33400	20500	12300
1989	13100	14200	13600	28800	31400	31500	31200	32400	29500	28100	10900	14800
1990	11500	11300	12100	26000	25800	25500	26800	28400	31600	26700	9300	12400
1991	14500	9300	11300	24400	24900	23100	25700	29800	32200	27900	9800	12600
1992	12800	10600	14100	23000	24900	26300	23800	22800	22000	17900	7800	12400
1993	13500	12700	12700	10700	17900	17300	8500	10900	18700	21200	20200	16500
1994	18300	17100	18900	23700	31500	30800	28800	29500	29900	30700	28000	18100
1995	16900	16900	20400	17800	19600	29000	35600	49400	54600	54400	53700	27500
AVE	17400	16200	19800	26200	29600	30900	33800	36200	36600	36000	32200	19600

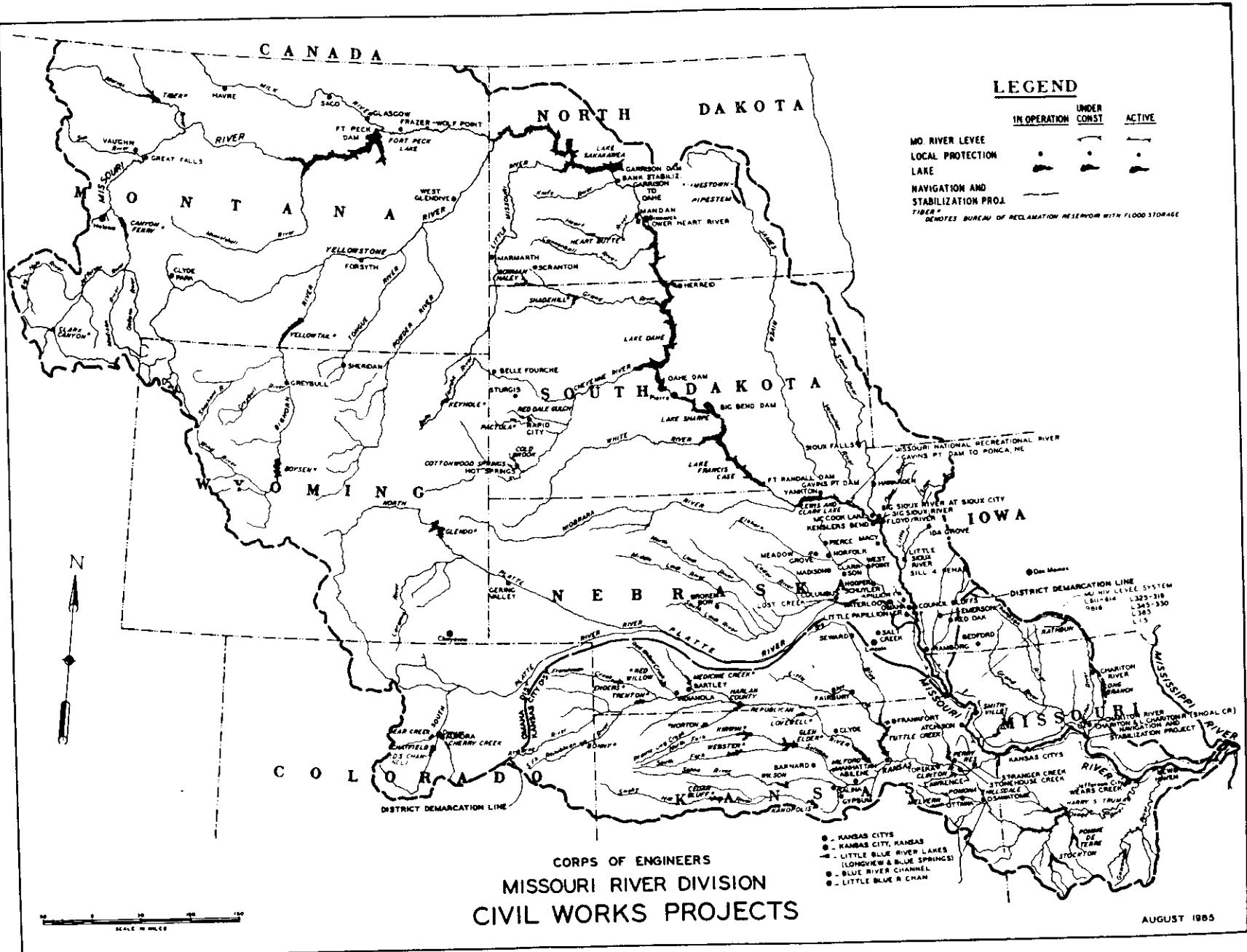
**TABLE II-2**  
**GAVINS POINT DAM**  
**MONTHLY OUTFLOW (C.F.S.)**

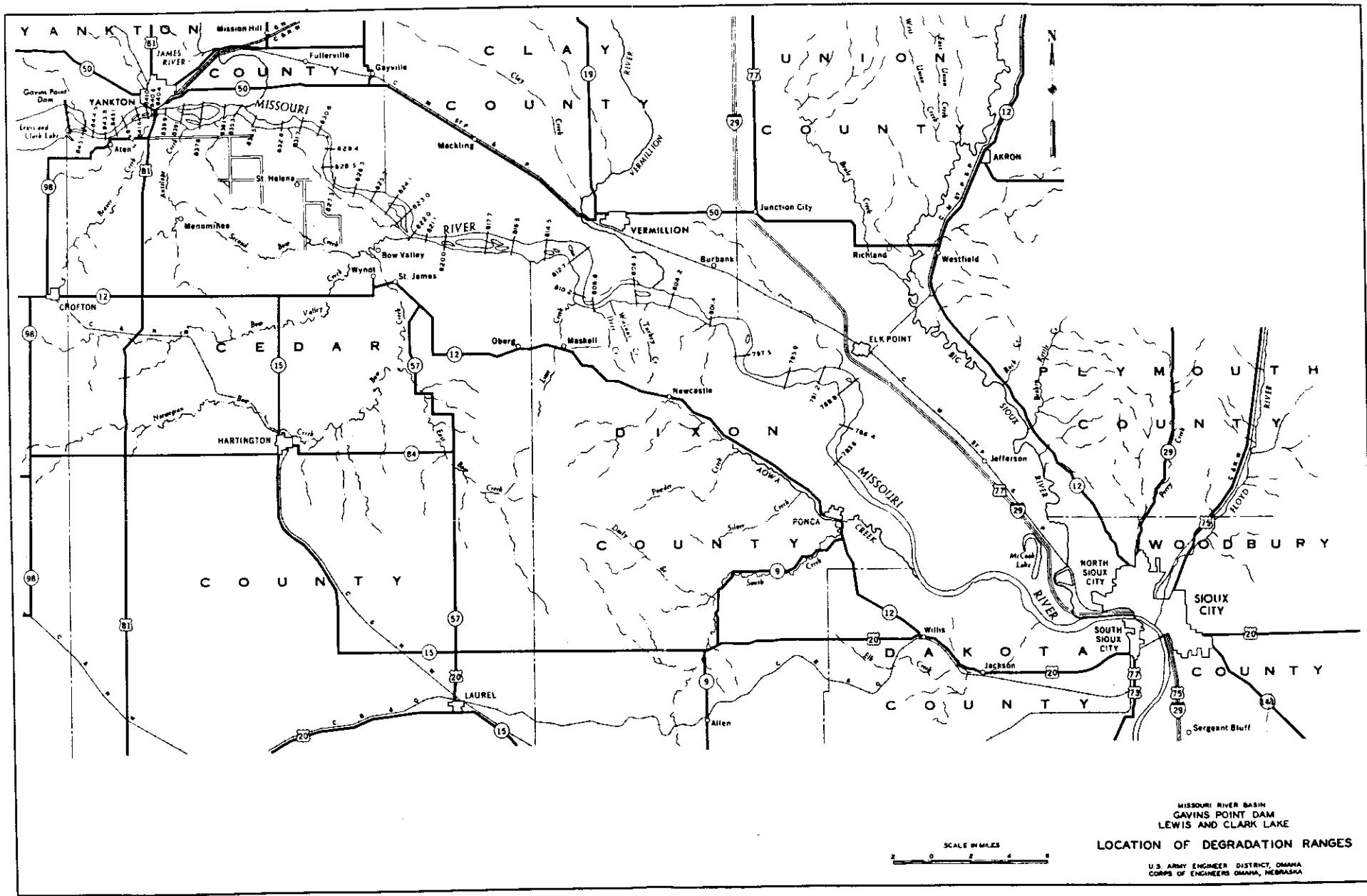
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1967						23700	29900	33500	33600	32800	29000	16500
1968	14700	16800	23600	32300	32500	32900	34800	33700	31500	30000	31500	17500
1969	16600	17500	18700	23100	33300	33500	34100	51800	51400	45500	40200	19800
1970	16000	17500	24300	29100	30300	34600	39900	43600	40600	41100	39200	19900
1971	16000	17700	25000	34500	43500	46700	45600	46100	47000	48300	49900	25700
1972	19900	20000	26100	39900	37300	39800	43100	46100	46300	48500	44500	21800
1973	20000	20000	19600	23000	27400	28700	30300	31500	30800	26100	27600	17000
1974	17100	18000	22500	30000	29600	29900	34200	34000	34600	34700	30200	17100
1975	17200	17100	19300	28200	31900	37500	52600	60100	60500	61000	61000	27000
1976	21400	23000	31200	34900	34800	36900	37000	37000	37000	35200	35100	22800
1977	18600	16100	21000	30200	31300	31700	33500	32500	31600	30800	27400	14300
1978	15500	16000	17500	21800	27900	38300	44400	49600	50000	51500	51900	26200
1979	20400	23000	14700	27900	36600	38400	35400	34000	34400	35800	34000	23900
1980	18900	16500	20200	29000	30000	29100	33900	34500	34300	34700	33500	15500
1981	13900	14000	22200	33300	32400	31100	32400	31600	33200	33400	18800	14100
1982	14500	14300	17800	28500	27700	27300	29900	30900	31800	34200	38600	27600
1983	22500	23000	20900	16900	24200	20200	27500	34900	34700	35000	34900	23400
1984	18600	19100	21900	15500	19700	16700	35200	42900	42600	41800	43000	24200
1985	20000	20000	20100	22300	27500	30300	31400	31100	29000	28800	30900	18600
1986	16000	17300	18000	17200	29100	34400	35000	36800	35600	39300	42700	33100
1987	25900	23000	22900	27900	28200	29100	29500	30600	30500	31700	31400	18000
1988	18000	18000	22900	29400	30400	31500	32000	32400	34900	33400	20200	12500
1989	12800	15500	13500	28700	31200	31500	30900	31700	28700	27900	10500	14700
1990	11600	12600	12100	26000	25800	25100	26700	27100	31100	26600	9300	12400
1991	14300	10400	11800	23900	24500	23200	25600	28600	31500	27800	9900	12600
1992	13000	10900	14100	22800	25000	26100	23900	22100	21900	17500	7500	12900
1993	13300	13000	12300	11200	17600	17000	8000	10800	18500	21000	20100	16600
1994	17900	17900	18700	23700	31400	30000	29100	28800	29800	30400	27800	17700
1995	17100	17600	20100	17400	18500	30100	35700	48800	54000	54100	53700	27600
AVE	17200	17400	19800	26000	29300	30500	33200	35800	36300	35800	32200	19700

## SUMMARY OF ENGINEERING DATA — MISSOURI RIVER MAIN STEM RESERVOIRS

ITEM NO.	SUBJECT	FORT PECK LAKE	GARRISON DAM — LAKE SAKAKAWEA	DAKE DAM — LAKE DAKE	BIG BEND DAM — LAKE SHARPE	FORT RANDALL DAM — LAKE FRANCIS CASE	DAVINS POINT DAM — LEWIS & CLARK LAKE	TOTAL	ITEM NO.	REMARKS	
1	Location of Dam	Near Glasgow, Mont.	Near Garrison, N. Dak.						1	(1) Includes 4,280 square miles of non-contributing areas.	
2	River Miles — 1980 mileage	Mile 1771.5	Mile 1386.9						2	(2) Includes 1,350 square miles of non-contributing areas.	
3	Total & Incremental Drainage Area, square miles	57,500	181,400 (2)	123,900	243,490 (1) 82,000	246,330 (1)	5,840	263,480 (1)	3	(3) With pool at base of head.	
4	Approximate length of full Reservoir (in Valley Miles)	134, ending near Zortman, Mont.	178, ending near Trenton, N.D.	231, ending near Bismarck, N.D.	80, ending near Pierre, S.D.	107, ending at Big Bend Dam	25, ending near Niobrara, Nebr.	14,150	1,350 (1)	4	(4) Storage first available for regulation of flows.
5	Shoreline — Miles (3)	1520 (El. 2234)	1340 (El. 1837.5)	25,800	15,400	28,900	3,300	28,900	5,840	5	(5) Damming height is height from low water to maximum operating pool. Maximum height is height from bottom to top of dam.
6	Average total & incremental drainage area, square miles	10,200							6	(6) Based on latest available storage data.	
7	Max. Discharge of Record near Dam site, cu. yds.	137,000 (June 1953)	348,000 (April 1952)	440,000 (April 1952)	440,000	(April 1952)	447,000	(April 1952)	7	(7) River regulation is attained by flow over low-crusted spillway and through tailgate.	
8	Construction started — Cal. yr.	1933	1946	1948	1950	1946	1952	1952	8	(8) From study 8-3-1952.	
9	In construction (4) Cal. yr.	1940	1955	1952	1954	1953	1955	1955	9	(9) Based on latest available storage data.	
10	DAM AND EMBANKMENT								10	(10) Storage first available for regulation of flows.	
11	Top of Dam, Elev. ft. msd	2280.5		1875	1880	1440	1385	1234	11	(11) Damming height is height from bottom to top of dam.	
12	Length of Dam in feet	21,028 (excluding spillway)	11,300 (including spillway)	9,300 (excluding spillway)	10,570 (including spillway)	10,700 (including spillway)	8,700 (including spillway)	71,500 feet	12	(12) Based on 8th year (1951) of drought drawdown. (From study 8-3-1952).	
13	Damming Height, feet (5)	220	180	200	78	140	45	863 feet	13	(13) Storage first available for regulation of flows.	
14	Maximum Height, feet (5)	250.5	210	245	95	165	74		14	(14) Storage first available for regulation of flows.	
15	Max. Base width, total & w/o Berms, feet	3500; 2700	3400; 2050	3500; 1500	1200; 700	4300; 1250	850; 450		15	(15) Storage first available for regulation of flows.	
16	Abutment Formations (Under Dam & Embankment)	Bearpaw shale and Glacial till	Fort Union Clay-Shale	Pierre shale	Pierre shale & Niobrara chalk	Niobrara Chalk	Niobrara chalk & Carlile shale		16	(16) Storage volumes are exclusive of Snake Creek arm.	
17	Type of fill	Hydraulic & rolled earth fill	Rolled earth fill	Rolled earth fill & shale berms	Rolled earth, shale, chalk fill	Rolled earth fill & chalk berms	Rolled earth fill & chalk fill	368,128,000 cu. yds.	17	(17) Based on latest available storage data.	
18	Fill quantity, cu. yds.	125,825,000	65,000,000	55,000,000 & 37,000,000	17,000,000	28,000,000 & 22,000,000	7,000,000	3,554,000 cu. yds.	19	(18) Volume of concrete (Cu. yds.)	
19	Date of closure	1,800,000	1,500,000	1,045,000	840,000	981,000	308,000	31 July 1953			
20	SPILLWAY DATA								20	(20) Soothree Creek.	
21	Location	Right bank — remote	Left bank — adjacent	Right bank — remote	Left bank — adjacent	Left bank — adjacent	Right bank — adjacent		21	(21) Based on study 8-3-1952.	
22	Crest Elevation, msd	2225	1825	1596.5	1348	1180			22	(22) By March 1988 all units will be rated at 40,000 kw.	
23	Width (including piers) in feet	820 gated	1336 gated	456 gated	1000 gated	884 gated			23	(23) Source: Annual Report on Civil Works Activities of the Corps of Engineers, Extract Report Fiscal Year 1988.	
24	No., Size and Type of Gates	16-40x25' Vertical Lift Gates	28-40x25' Tainter	8-40x23.5' Tainter	21-40x29' Tainter	14-40x30' Tainter			24	(24) Affected by level of Lake	
25	Design Discharge Capacity, cu. ft./sec.	275,000 at elev. 2253.3	827,000 at elev. 1858.5	304,000 at elev. 1844.4	620,000 at elev. 1379.3	580,000 at elev. 1221.4			25	(25) Affected by level of Lake	
26	Discharge Capacity at Maximum Operating Pool, cu. ft./sec.	275,000	860,000	80,000	270,000	345,000					
27	RESEVOIR DATA (8)								26		
28	Max. Operating Pool Elev. & Area	2250 msd	249,000 acres	1854 msd	362,000 acres	1620 msd	373,000 acres	1210 msd	31,000 acres	27	
29	Max. Nor. Op. Pool Elev. & Area	2246 msd	240,000 acres	1850 msd	365,000 acres	1617 msd	359,000 acres	1205 msd	28,000 acres	28	
30	Base Flood Control Elev. & Area	2234 msd	212,000 acres	1637.5 msd	307,000 acres	1607.5 msd	312,000 acres	1204.5 msd	25,000 acres	29	
31	Min. Oper. Pool Elev. & Area	2160 msd	92,000 acres	1775 msd	129,000 acres	1540 msd	117,000 acres	1203 msd	41,000 acres	30	
32	Stor. Allocation, Elev. & Cap.	2250-2246	977,000 a.f.t.	1,484,000 a.f.t.	1,080-1815	1,080,000 a.f.t.	1,425-1422	80,000 a.f.t.	985,000 a.f.t.	31	
33	Exclusive Flood Control	2248-2234	2,704,000 a.f.t.	1,850-1837.5	4,220,000 a.f.t.	1,617-1607.5	3,188,000 a.f.t.	1,422-1420	117,000 a.f.t.	32	
34	Flood Control & Multiple Use	2234-2160	10,945,000 a.f.t.	1,837.5-1775	13,219,000 a.f.t.	1,607.5-1540	13,003,000 a.f.t.	1,350-1350	79,000 a.f.t.	33	
35	Carryover Multiple Use	2160-2030	4,263,000 a.f.t.	1,775-1673	4,960,000 a.f.t.	1,540-1415	5,451,000 a.f.t.	1,340-1345	1,568,000 a.f.t.	34	
36	Inactive	2250-2030	18,908,000 a.f.t.	1,854-1673	23,923,000 a.f.t.	1,620-1415	23,338,000 a.f.t.	1,343-1345	5,574,000 a.f.t.	35	
37	Gross Reservoir Filling Initiated	November 1937							36		
38	Reservoir Filling Initiated	27 May 1942							37		
39	Initially reached Min. Oper. Pool	7 August 1955									
40	Est. Annual Sediment Inflow	36,100 a.f.t.									
41	Est. Annual Sediment Inflow	17,500 a.f.t.									
42	OUTLET WORKS DATA								38		
43	Location	Right bank	Right bank	Right bank	Right bank	Left bank	Left bank		39		
44	Number and size of conduits	2-24" dia. (No. 3 & 4)	1-26" dia. & 2-22" dia.	1-19.75" dia. upstream; 18.25" dia. downstream	None (7)	1013	None (7)		40		
45	Length of Conduits in feet (8)	No. 3-8,815. No. 4-7,240	1528	3498 to 3659	2-11'x23' per conduit, vertical lift, cable suspension.				41		
46	No., Size and Type of Service Gates	1-26" cylindrical gate per conduit for fine regulation	1-19x24.5' Tainter gate per conduit for fine regulation	1-13'22" per conduit, vertical lift; 4" cable suspension and 2" hydraulic suspension (fine regulation)							
47	Entrance Invert Elevation	2085	1872	1425	1386 (12)	1228	1180 (12)		42		
48	Avg. Discharge Cap. per conduit & total	Elev. 2250	30,400 cfs-98,000 cfs	Elev. 1820	Elev. 1375	32,000 cfs-128,000 cfs			43		
49	Present Tailwater Elev. (msf)	2032-2036	5,000-35,000 cfs	1972-1980	1923-1928	1230-1239	1156-1185	18,000-80,000 cfs	44		
50	POWER FACILITIES AND DATA								45		
51	Avg. Gross Head avail. in ft. (13)	184	181	174	70	117	48		46		
52	Number and size of conduits	1-24" dia.; No. 2-22" dia.	5-26" dia., 25' penstocks	None; direct intake	8-26" dia., 22' penstocks	None	None; direct intake		47		
53	Length of conduit in feet (8)	No. 4-603; No. 24,260	1,828	From 3,280 to 4,000	1,074	40,000	40,000		48		
54	Surge Tanks	PH#1: 3-40" dia.; PH#2: 245" dia.	65" dia., 2 per penstock	70" dia., 2 per penstock	None	58,003	58,003 test				
55	No., type and speed of turbines	5-Francis, PH#1-2-126.5, 1-164 rpm; PH#2-2-128.8 rpm	5-Francis, 80 rpm	7 Francis, 100 rpm	8-Fixed blade, 51.8 rpm	8-Francis, 87 rpm	3-Kaplan, 75 rpm		49		
56	Disc. Cap. at Rated Head-cfs	PH#1 units 1 & 3 170', 2-140'	190'	54,000 cfs	87'	103,000 cfs	44,500 cfs	36,000 cfs	50		
57	Gen. Nameplate Rating, kw	8,800 cfs, PH#2-170'-7,200 cfs	36,000 cfs	54,000 cfs	100,000	98,500	2-33,350; 1-40,400 (14)		51		
58	Plant capacity, kw	185,250	475,000	700,000	468,000	320,000	107,100		52		
59	Dependable capacity, kw (9)	181,000	395,000	834,000	487,000	283,000	74,000		53		
60	Average Annual Energy	1,044	2,364	1,001	1,745	700	6,838		54		
61	Million kw-hr (13)	July 1943 — June 1951	January 1954 — October 1960	April 1962 — June 1963	October 1964 — July 1966	March 1964 — January 1966	September 1965 — January 1967	July 1943 — July 1966	55		
62	Initial Gen. First & Last Unit								56		
63	Completed project (15)	\$158,500,000	\$289,936,000	\$346,800,000	\$107,500,000	\$198,100,000	\$46,800,000	\$1,161,136,000	57	October 1987	

Corps of Engineers, U.S. Army  
Compiled by Missouri River Division





## CHAPTER III - WATER SURFACE PROFILES

### DATA AVAILABLE

Water surface profile data are available for many years. This study uses water surface profiles for years 1956, 1965, 1986 and 1994. Each profile was adjusted or shifted to a common discharge of 30,000 c.f.s. This discharge was selected as the value which most closely represented the overall average flow for the period covered by the water surface profiles.

The adjustment, or shift value, to be applied to each water surface profile was the difference between the actual water surface profile elevation and the gaging station elevation at the selected adjusted discharge. This difference is applied to the actual water surface profile elevations on a mileage distance pro-rate basis. A tabulation of the adjusted water surface profiles is shown in Table III-1.

### TREND EVALUATION

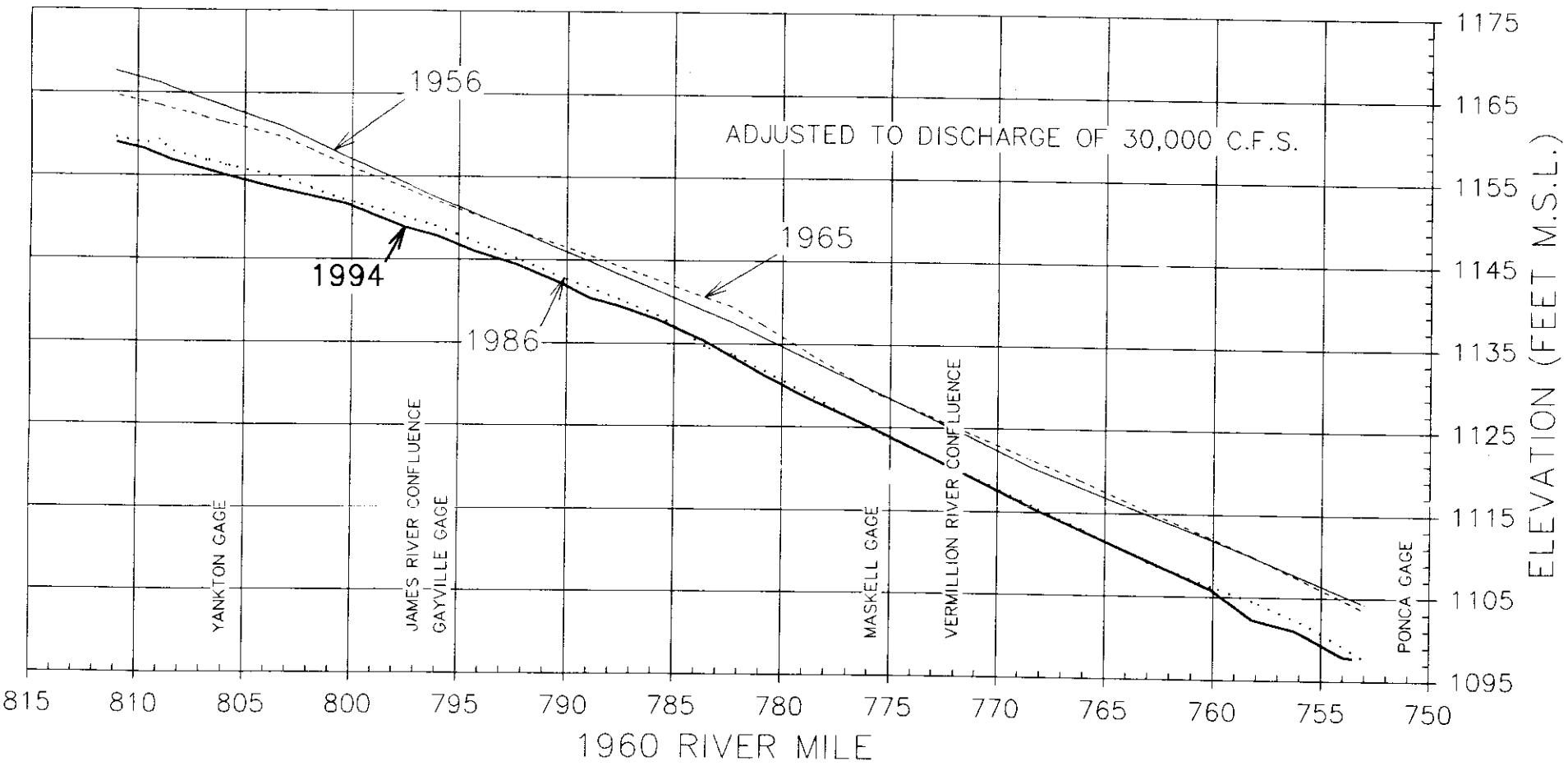
The changes of water surface elevation at different years are shown on Plates III-1, III-2 and III-3 for different river reaches.

Generally, decreasing stage elevations are noted from immediately below Gavins Point Dam throughout the remainder of the degradation reach. The greatest decreases in stage elevation over time occur from just below the dam and extends about 20 miles downstream to about RM 790. Downstream of RM 790, stage elevations continue to decrease, but the rate of change is less than the upstream reach.

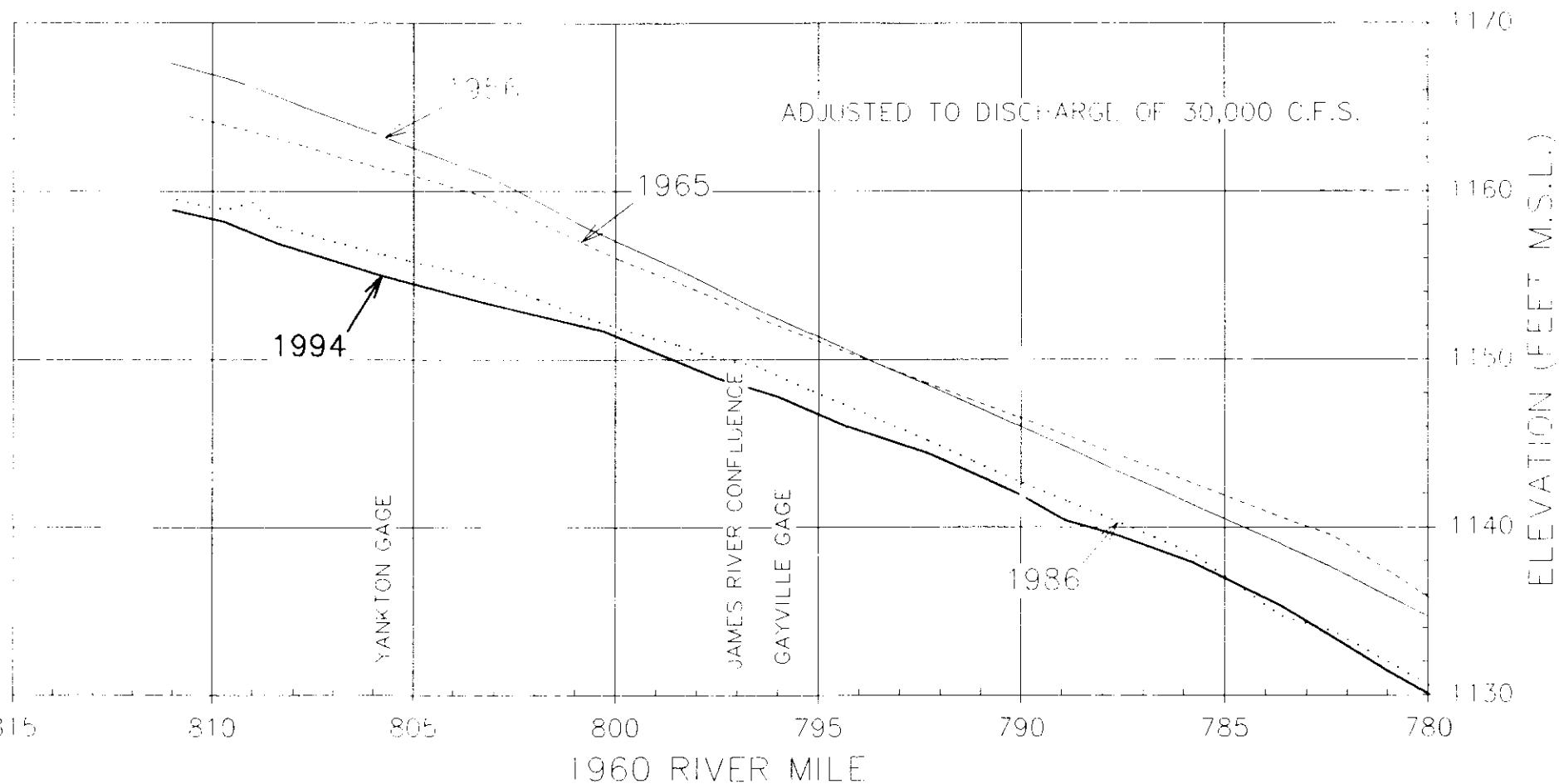
**Table III-1**  
**Missouri River Below Gavins Point Dam**  
**Adjusted Water Surface Profiles**

<b>River Mileage</b>		<b>Adjusted Water Surface Profiles (30,000 c.f.s)</b>			
<b><u>1941</u></b>	<b><u>1960</u></b>	<b><u>1956</u></b>	<b><u>1965</u></b>	<b><u>1986</u></b>	<b><u>1994</u></b>
783.60	753.18	1104.4	1103.7	1097.9	1095.7
786.40	755.56	1107.0	1106.7	1101.6	1100.1
788.80	758.24	1109.9	1110.0	1104.6	1102.3
791.20	760.15	1111.9	1112.1	1106.3	1106.0
793.90	762.77	1114.6	1115.0	1108.8	1109.3
797.50	766.13	1118.0	1118.8	1113.0	1113.0
801.40	768.41	1120.4	1121.3	1115.8	1115.5
804.20	771.22	1123.9	1124.3	1119.2	1119.1
806.30	773.36	1126.5	1126.7	1121.8	1121.9
808.50	775.80	1129.5	1129.3	1124.8	1124.9
810.20	776.70	1130.6	1130.7	1126.0	1126.0
812.70	778.90	1133.3	1134.1	1129.1	1128.6
814.70	780.92	1135.8	1137.3	1131.9	1131.3
816.50	782.36	1137.6	1139.5	1133.8	1133.5
817.70	783.61	1138.9	1140.6	1134.7	1135.3
820.00	785.75	1141.3	1142.6	1138.4	1137.9
821.10	786.73	1142.4	1143.5	1139.4	1138.7
822.00	787.60	1143.3	1144.3	1140.3	1139.5
823.00	788.90	1144.8	1145.5	1141.6	1140.4
824.10	790.12	1146.1	1146.6	1142.8	1142.0
825.20	791.24	1147.3	1147.6	1144.0	1143.2
826.30	792.34	1148.5	1148.6	1145.2	1144.4
827.30	793.60	1149.8	1149.8	1146.5	1145.4
828.50	794.25	1151.5	1151.2	1148.1	1146.9
829.40	795.13	1151.6	1151.3	1148.2	1147.0
830.60	796.51	1153.0	1152.5	1149.4	1148.3
831.70	797.50	1154.2	1153.6	1150.1	1148.9
832.80	798.51	1155.4	1154.6	1150.9	1149.9
834.50	799.87	1156.9	1155.9	1151.8	1151.3
835.30	800.85	1158.1	1157.0	1152.6	1152.0
836.10	801.93	1159.4	1158.2	1153.6	1152.6
837.60	803.25	1161.0	1159.7	1154.8	1153.4
839.10	804.28	1161.9	1160.4	1155.4	1154.0
839.90	805.17	1162.7	1161.0	1155.9	1154.6
840.40	805.72	1163.2	1161.3	1156.2	1155.0
840.60	805.89	1163.4	1161.4	1156.3	1155.1
841.00	806.16	1163.6	1161.6	1156.5	1155.3
841.60	806.83	1164.2	1162.1	1156.9	1155.8
842.50	807.75	1165.0	1162.7	1157.5	1156.4
843.10	808.39	1165.6	1163.1	1157.9	1156.9
843.80	809.00	1166.2	1163.5	1159.3	1157.5
844.50	809.66	1166.7	1163.9	1158.9	1158.2
845.10	810.15	1167.0	1164.2	1159.1	1158.4
846.50	811.05	1167.6	1164.7	1159.6	1158.9

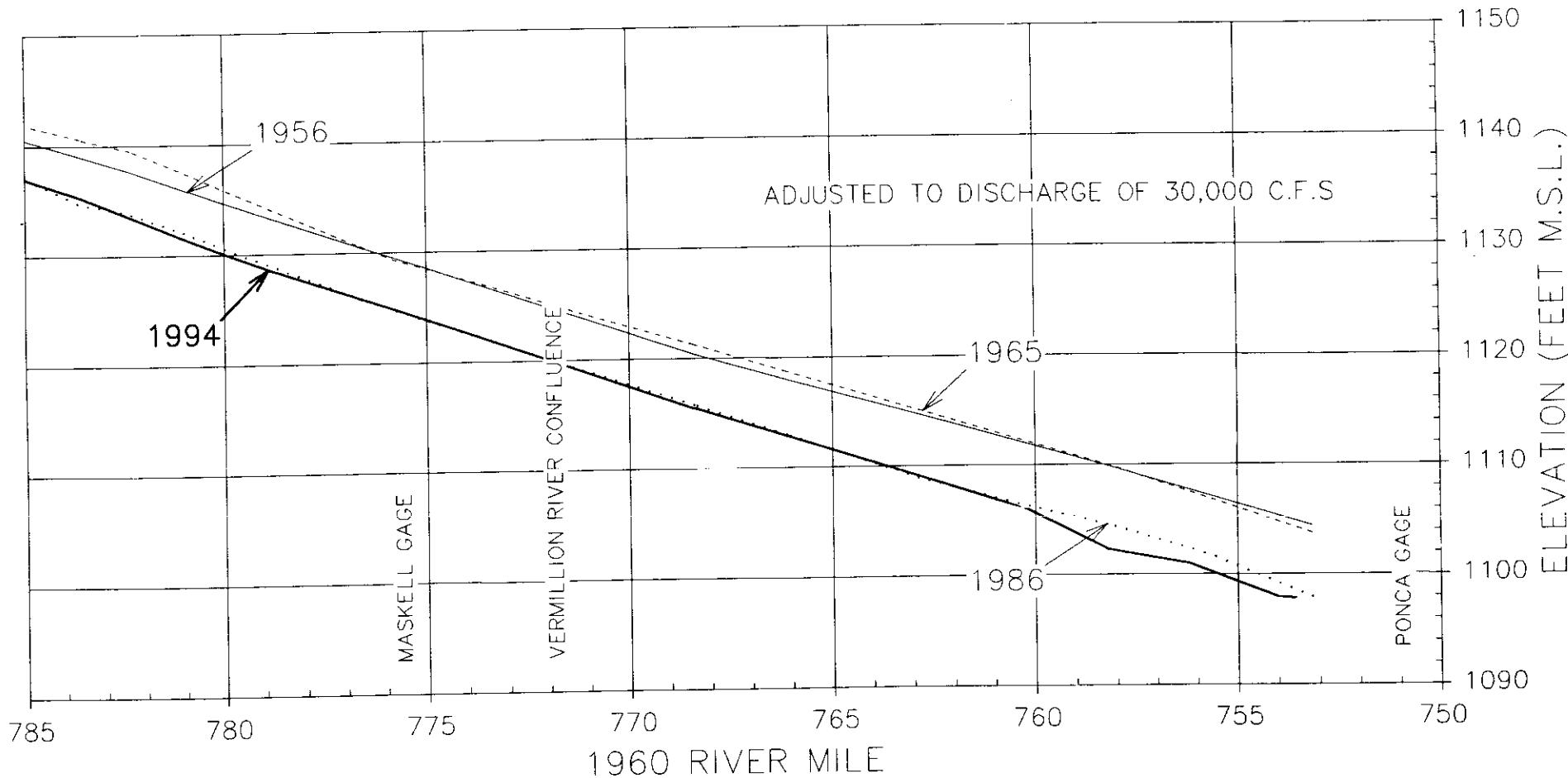
MISSOURI RIVER BELOW GAVINS POINT DAM  
WATER SURFACE PROFILE  
ENTIRE REACH



MISSOURI RIVER BELOW GAVINS POINT DAM  
WATER SURFACE PROFILE  
R.M. 815 – R.M. 780



MISSOURI RIVER BELOW GAVINS POINT DAM  
WATER SURFACE PROFILE  
R.M. 785 – R.M. 750



## CHAPTER IV - STAGE-DISCHARGE RELATIONSHIPS

### TAILWATER RATING CURVES

Hourly powerhouse release tables in conjunction with stage elevation scrolls were used to determine rating curves. From these rating curves, tailwater elevations were determined for discharges of 10,000 cfs, 20,000 cfs, and 30,000 cfs and plotted on a time scale.

Plate IV-1 shows the tailwater trend for 10,000, 20,000 and 30,000 cfs. Between 1956 and 1980, the tailwater declined steadily for all discharges for total change of 7 to 8 feet. From 1980 to present, only a 1 to 2 feet decrease in tailwater elevation has been observed.

### STREAMFLOW GAGING STATIONS

Stage-discharge relationships are available for three gaging stations in this river reach. See Table IV-1 for general information on these gaging stations. These data are plotted in Plates IV-2, IV-3, and IV-4.

Table IV-1. Missouri River Below Gavins Point Dam - Streamflow Gaging Stations

River Mile Location		U.S.G.S. Gage Station Number	Gage Name/Location
1941 Miles	1960 Miles		
830.2	796.0	6478515	Gayville
808.5	775.8	(Corps Gage)	Maskell
781.4	751.0	(Corps Gage)	Ponca

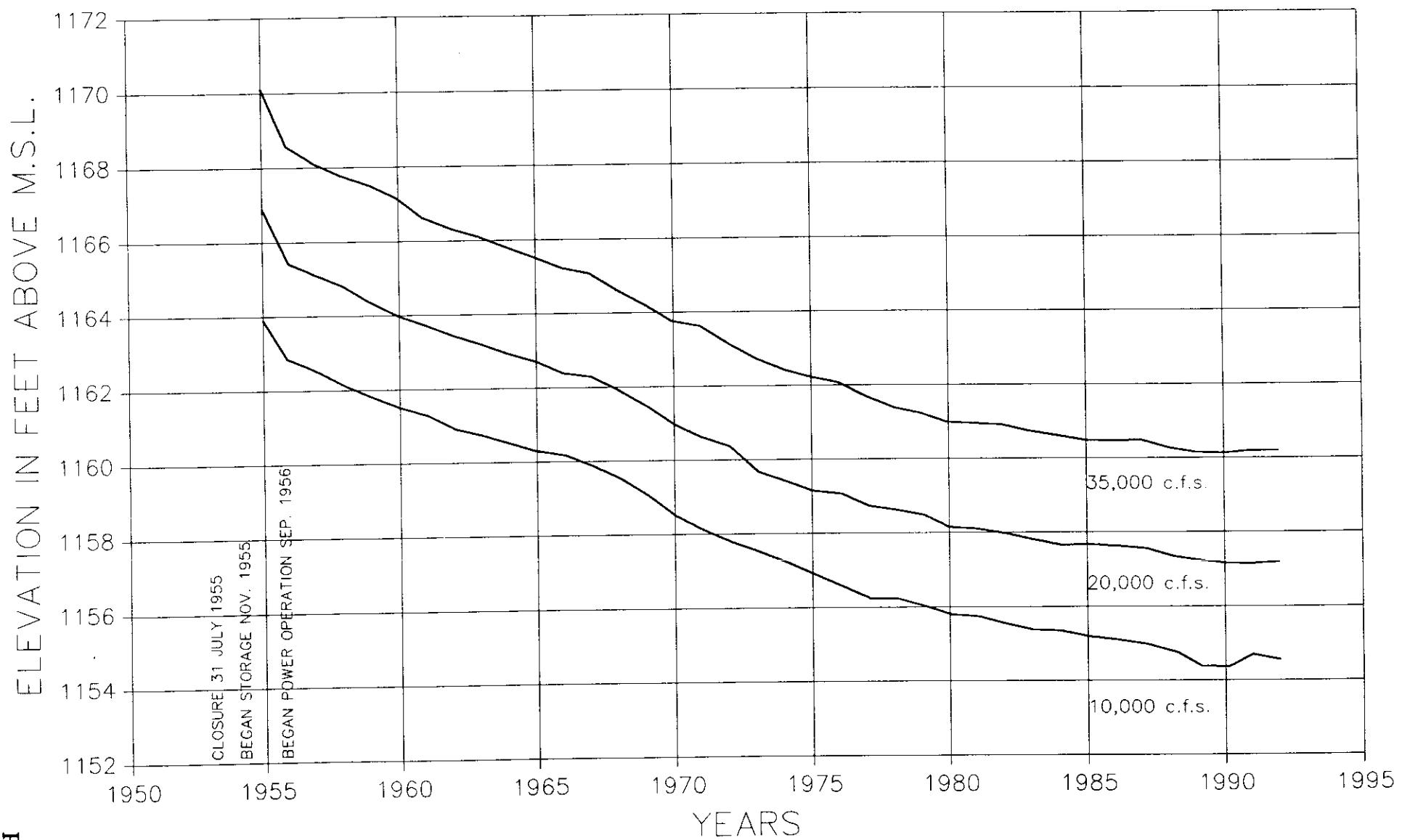
### TREND EVALUATION

Gayville Gage Station. The Gayville Station is located at 1960 RM 796.00. As shown on Plate IV-2, the water surface drops slightly between 1955 and 1967. Between 1967 and 1979, the water surface elevation drops sharply except for an irregular jump at 20,000 cfs in 1977. From 1982 to 1991, the water surface declines steadily and shows little change after 1991. This could be explained by the drought years in the late 80's and early 90's.

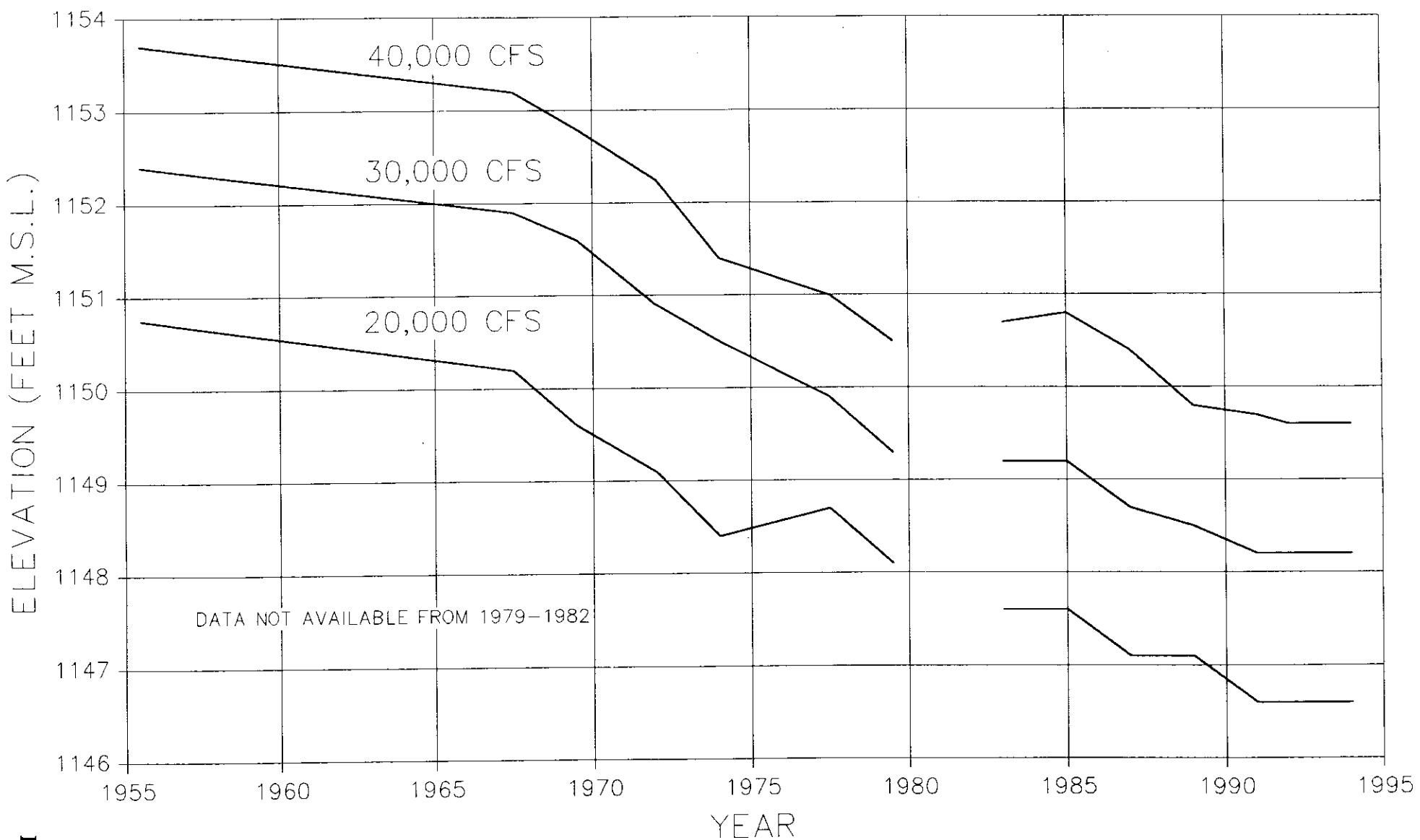
Maskell Gage Station. The Maskell Station is located at 1960 RM 775.8. As shown on Plate IV-3, between 1955-1967 the water surface drops very little. After 1967 the water surface drop becomes sharper with the exception of an abrupt increase during 1975-1976. After 1986, the water surface elevation decreases slightly at higher discharges, then starts to drop more sharply after 1993. At lower discharges, the water surface is rather steady. Channel widening could be occurring in later years. Bed armoring is a possible reason for a decreased degradation trend. The jump in the mid 70's could be caused by sandbars moving through the area.

Ponca Gage Station. The Ponca Station is located at 1960 RM 751.0. As shown on Plate IV-4, the trends of the change of rating curves for this gaging station are erratic, especially for 10,000 cfs discharge. No data is available between 1980 and 1986. After 1989, the water surface elevation begins to increase slightly, then drops sharply after 1993 which was a record high water year.

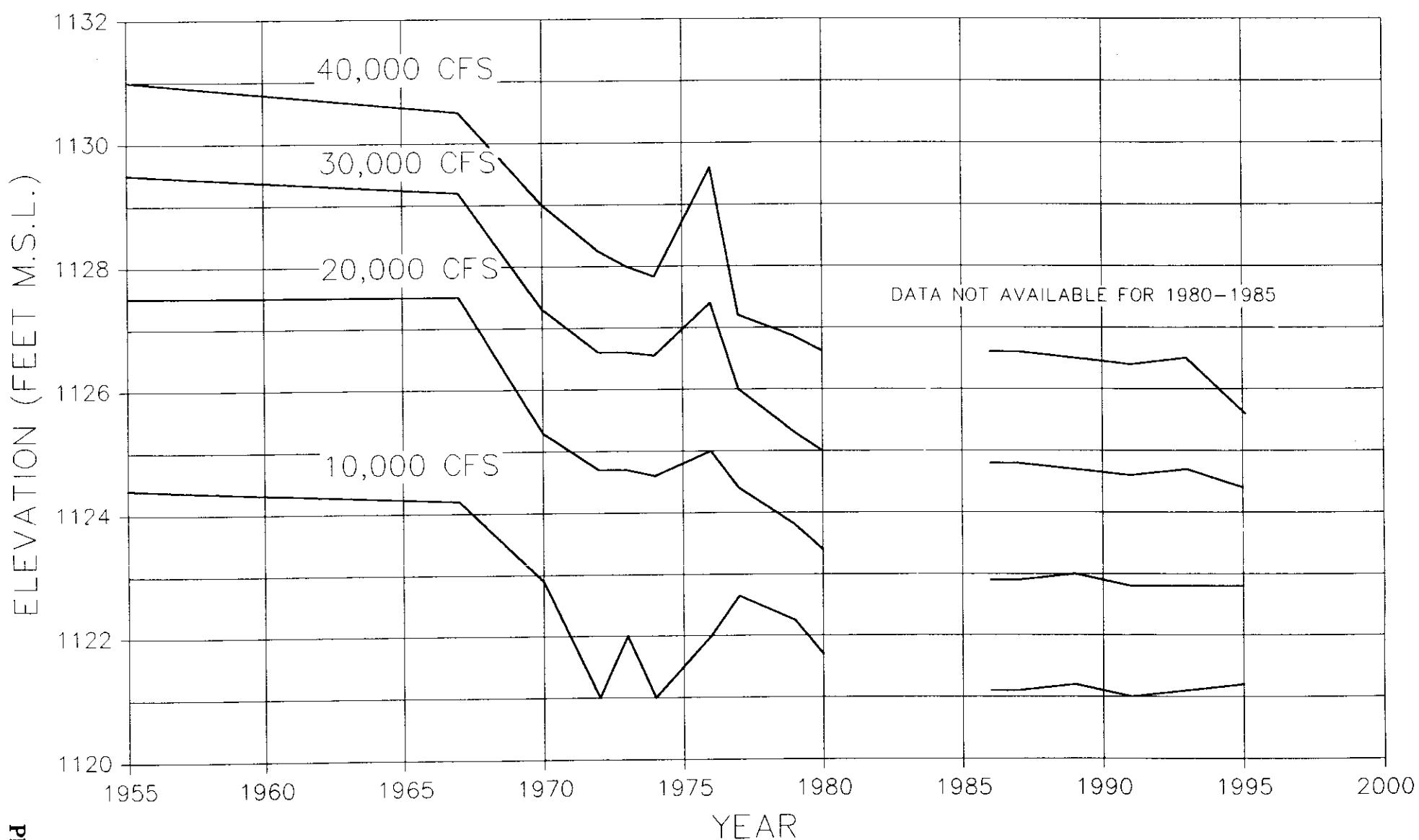
## GAVINS POINT PROJECT TAILWATER TRENDS



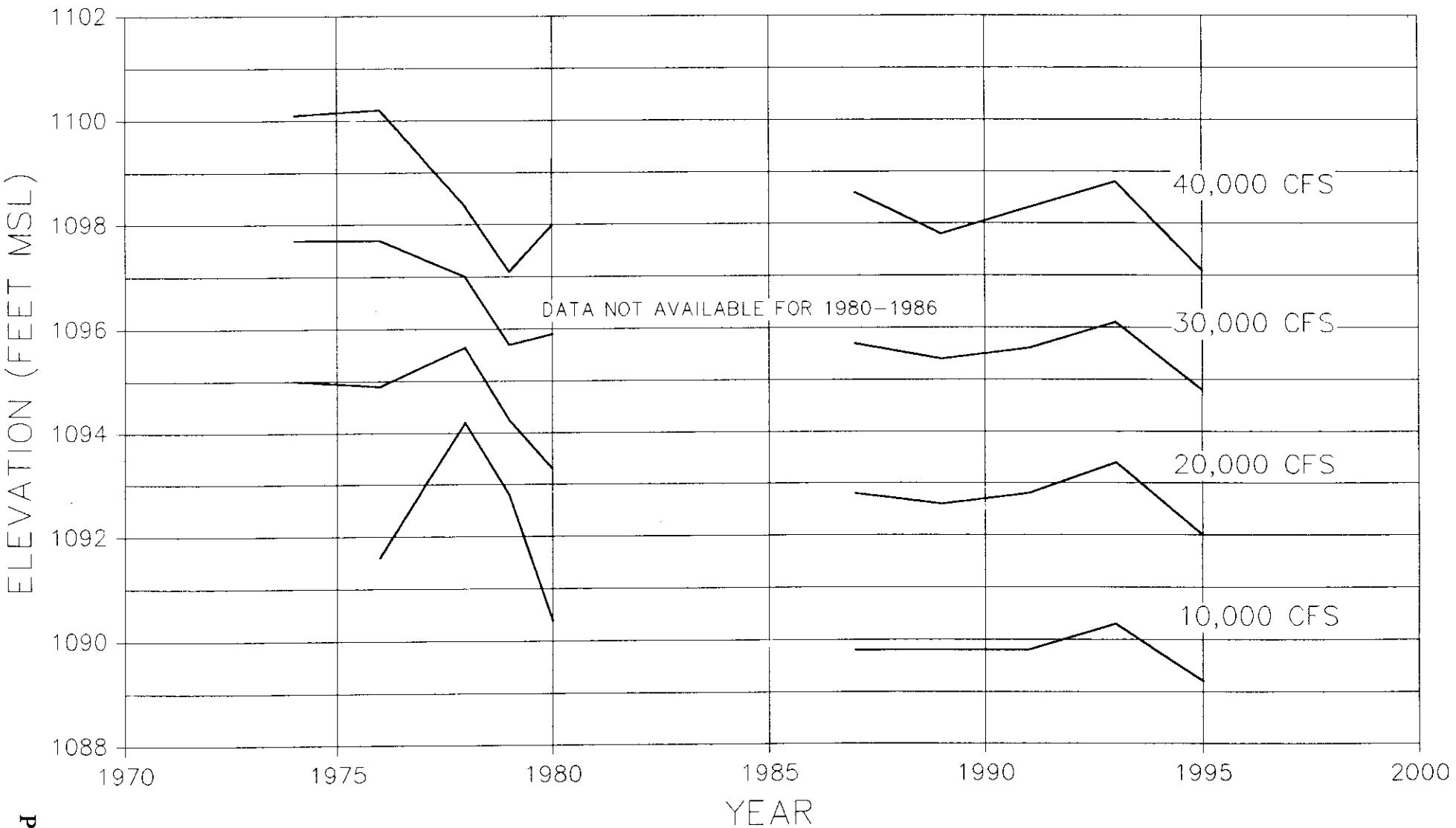
GAVINS POINT DEGRADATION REACH  
GAYVILLE GAGE STATION TRENDS



## GAVINS POINT DEGRADATION REACH MASKELL GAGE STATION TRENDS

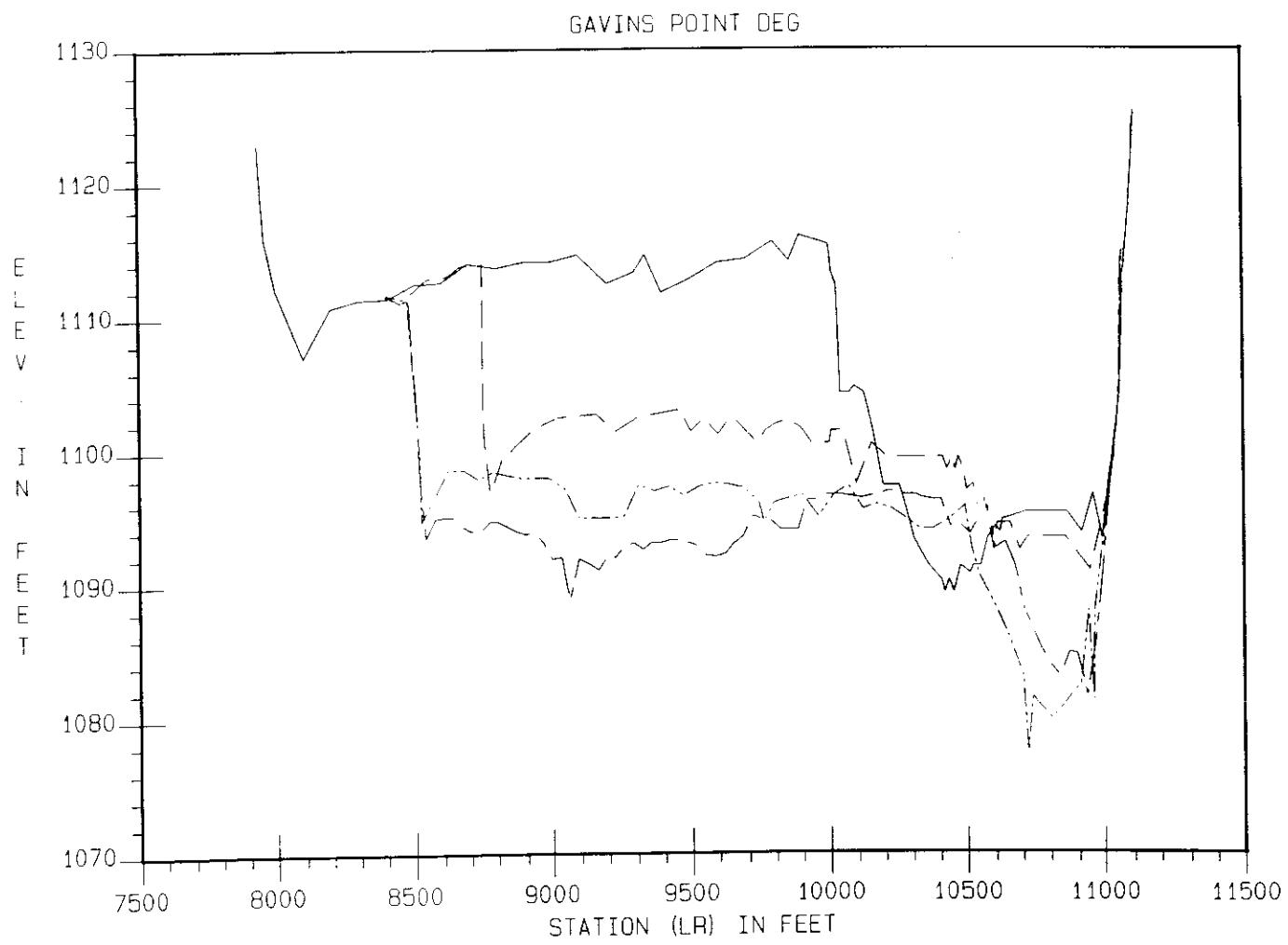


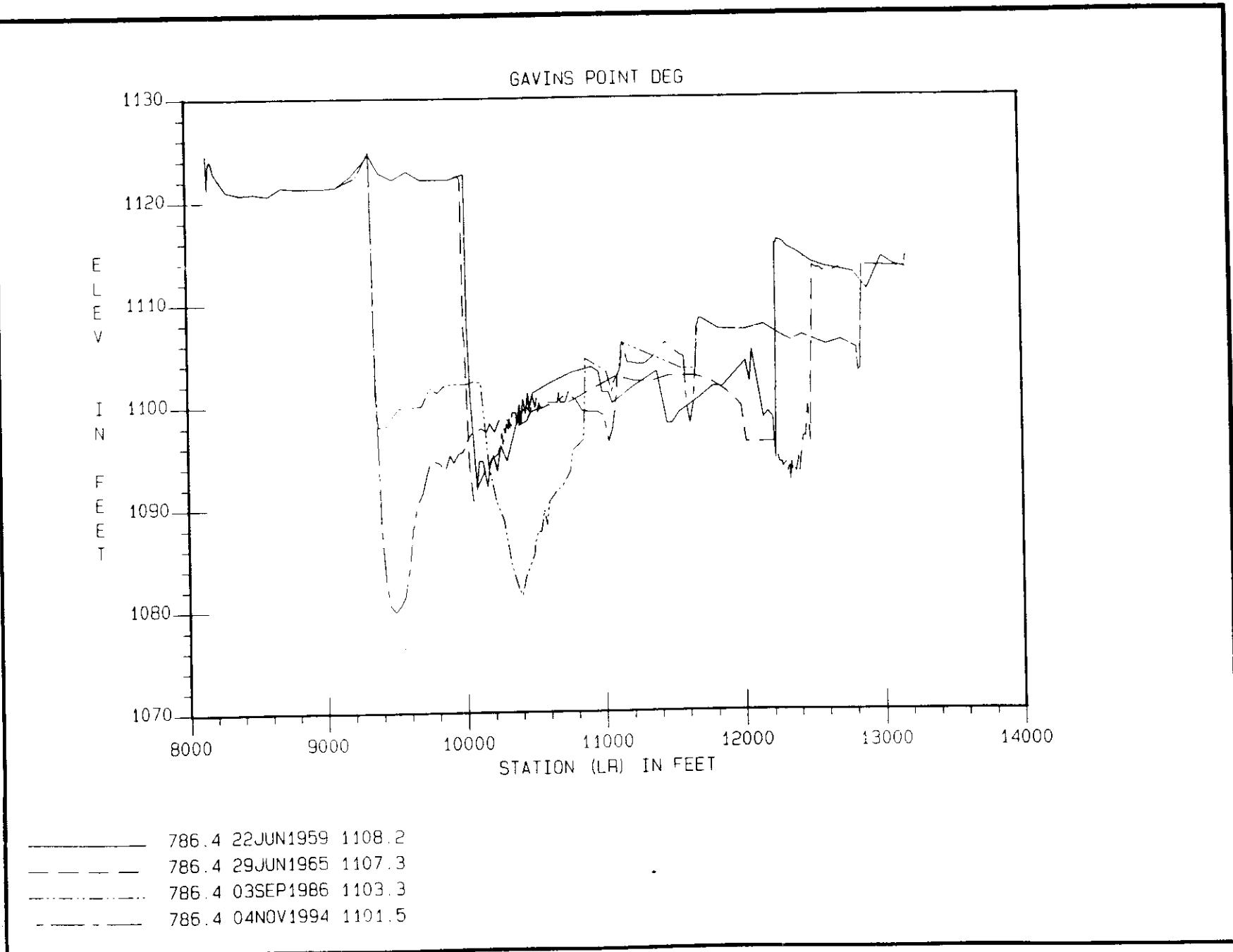
GAVINS POINT DEGRADATION REACH  
STAGE TRENDS  
PONCA GAGE (RM 751.0)

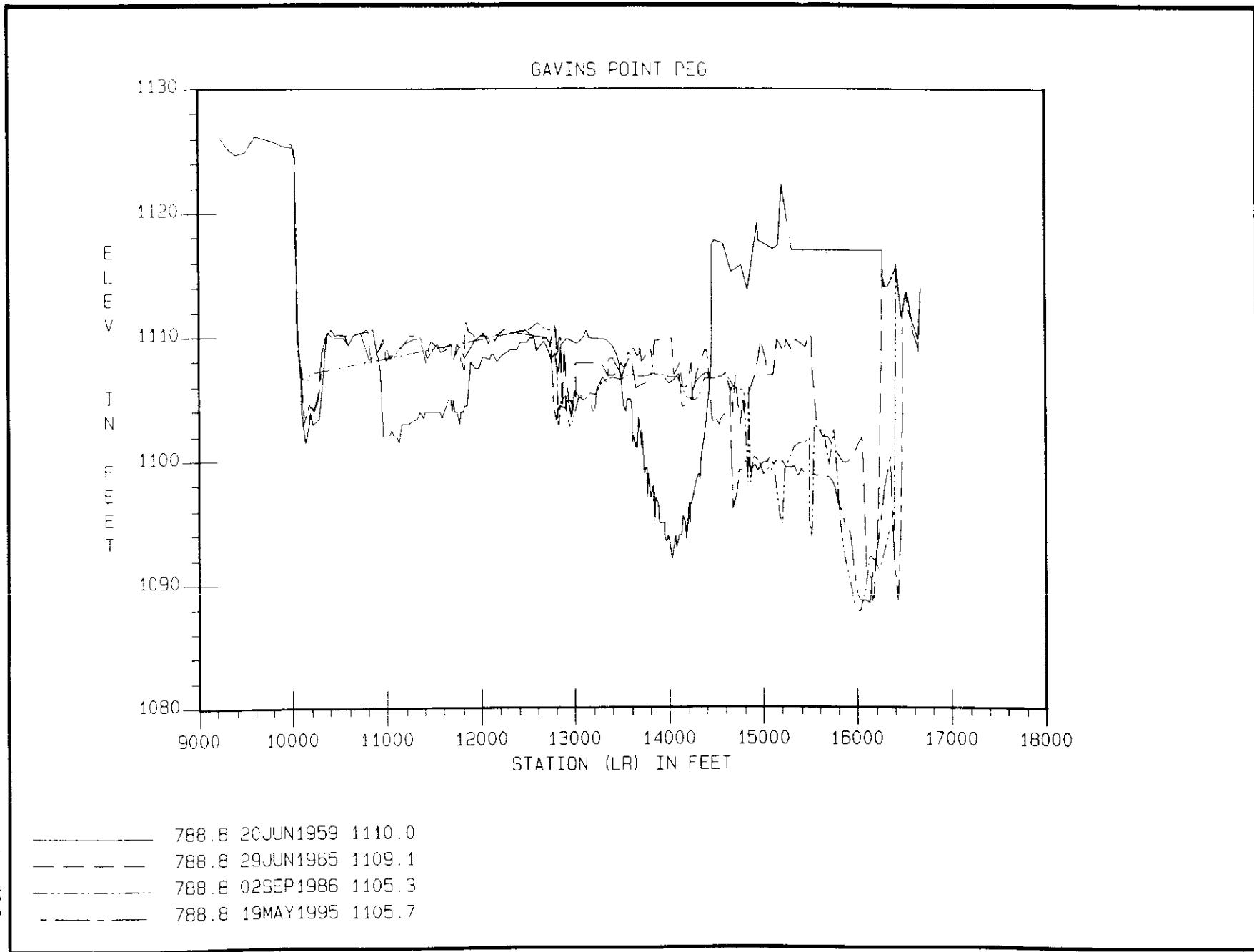


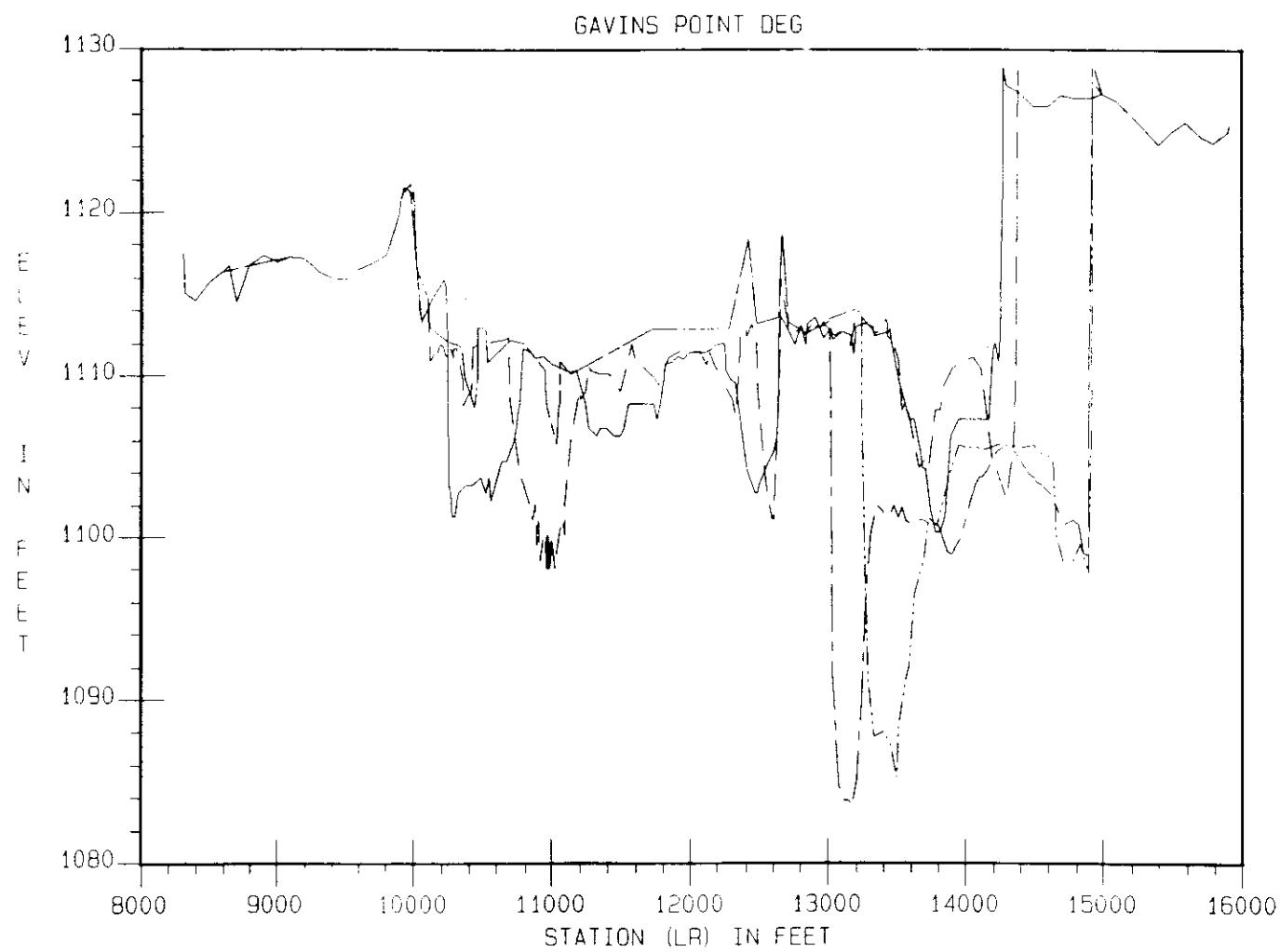
## CHAPTER V - SEDIMENT RANGE CROSS-SECTION DATA

Forty-three sediment rangelines are located in this reach. Most ranges were surveyed in 1955. Generally, all ranges were surveyed in 1959, 1960, 1965, 1970, 1974, 1980, 1986 and 1994. For purposes of presentation and simplification, only four survey years are plotted. The years 1959, 1965, 1986 and 1994 are plotted because they contain the most complete data sets. The cross-section plots are shown on Plates V-1 through V-43. These survey years were also used in water surface profile plots and hydraulic element parameters analysis.







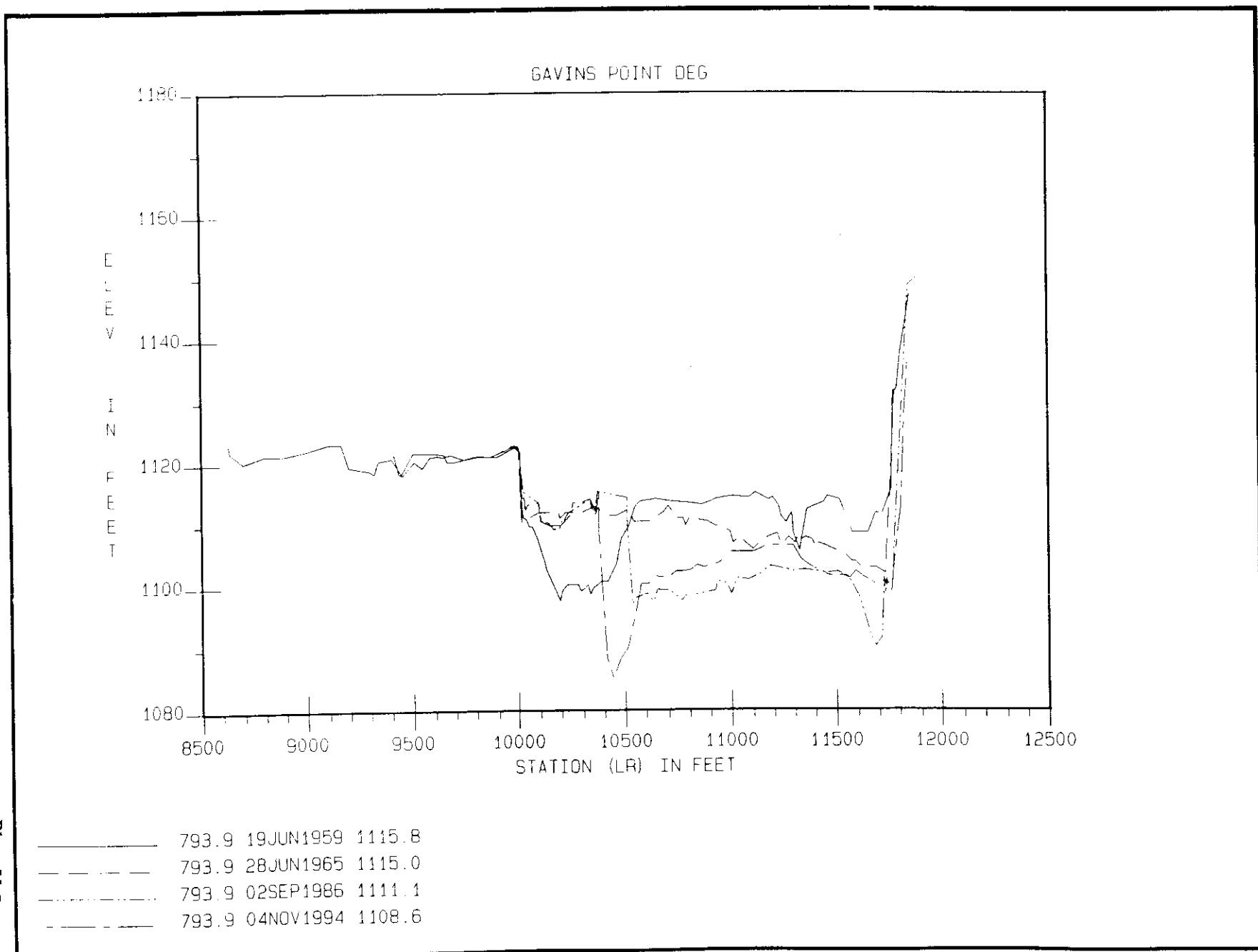


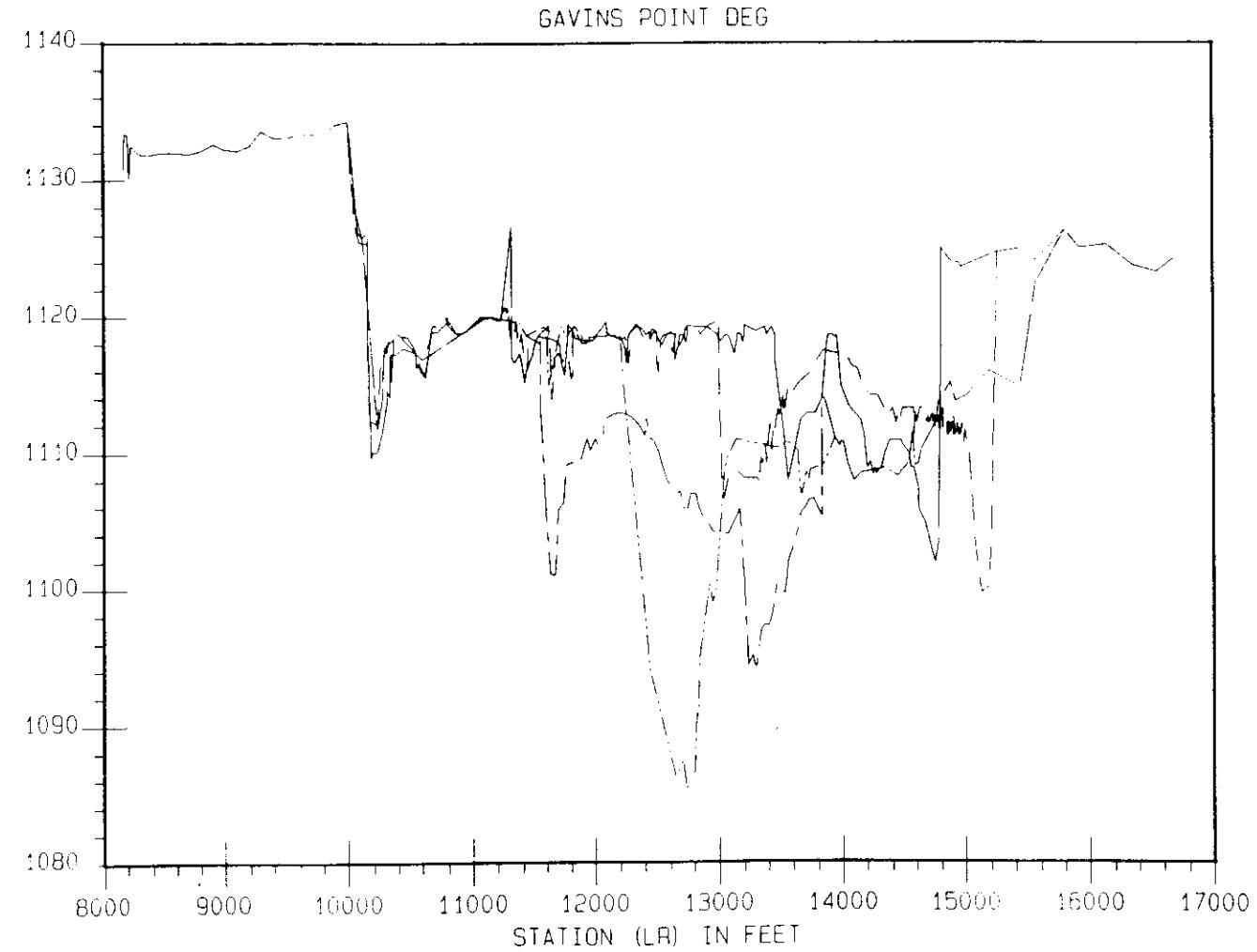
— 791.2 19JUN1959 1112.3

- - - 791.2 29JUN1965 1112.2

- - . 791.2 02SEP1986 1108.0

- - - - 791.2 15SEP1994 1106.0



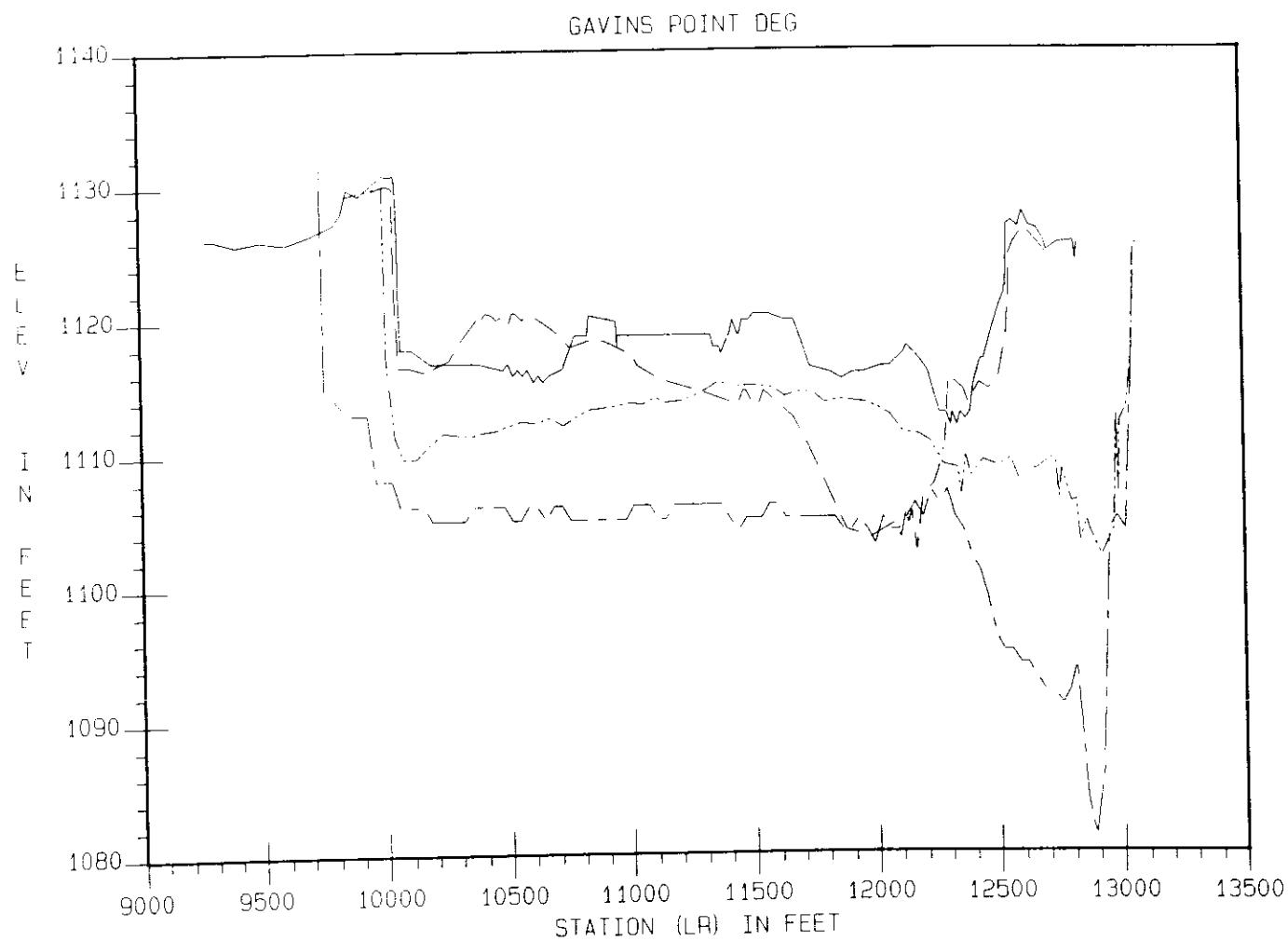


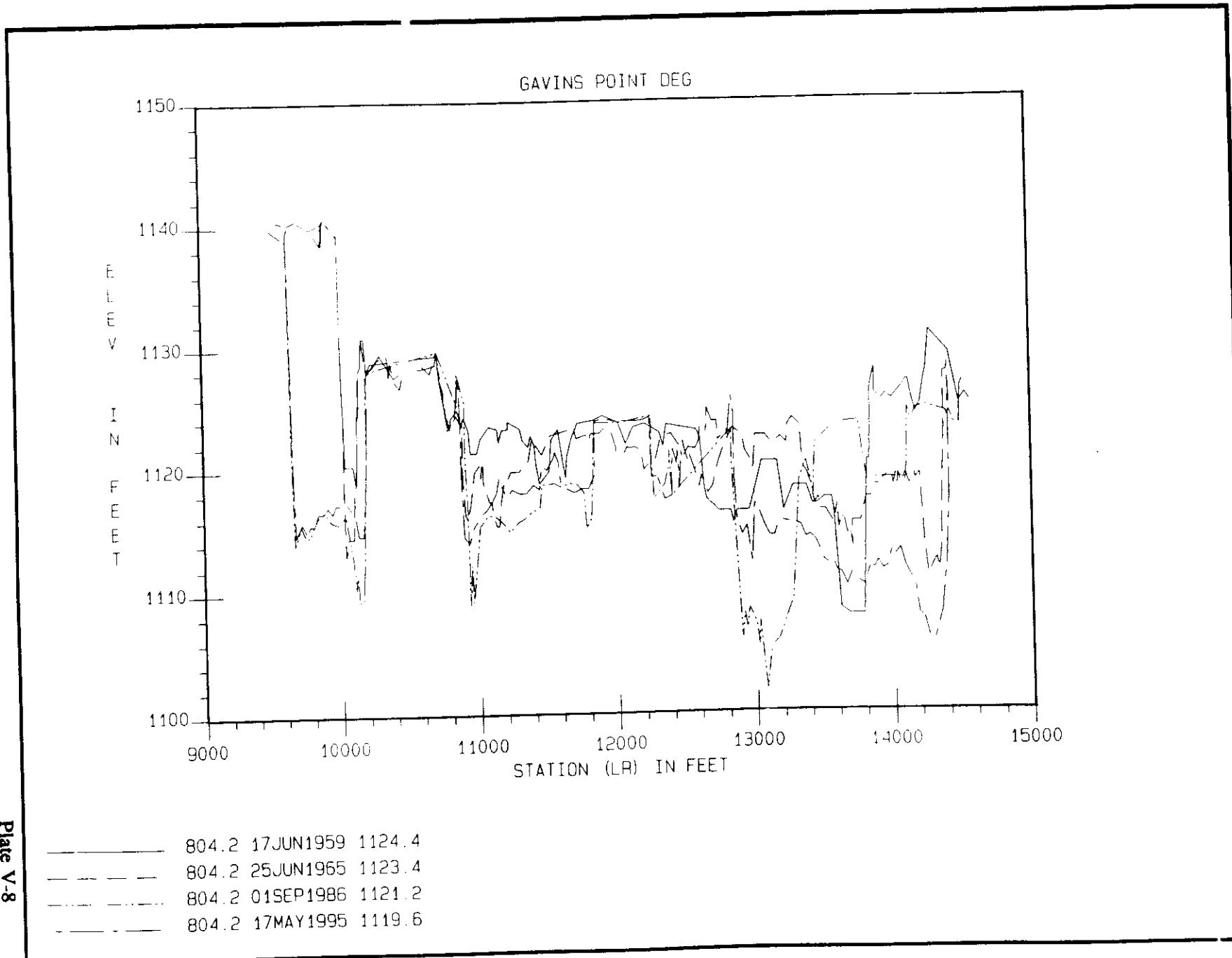
797.5 19JUN1959 1118.7

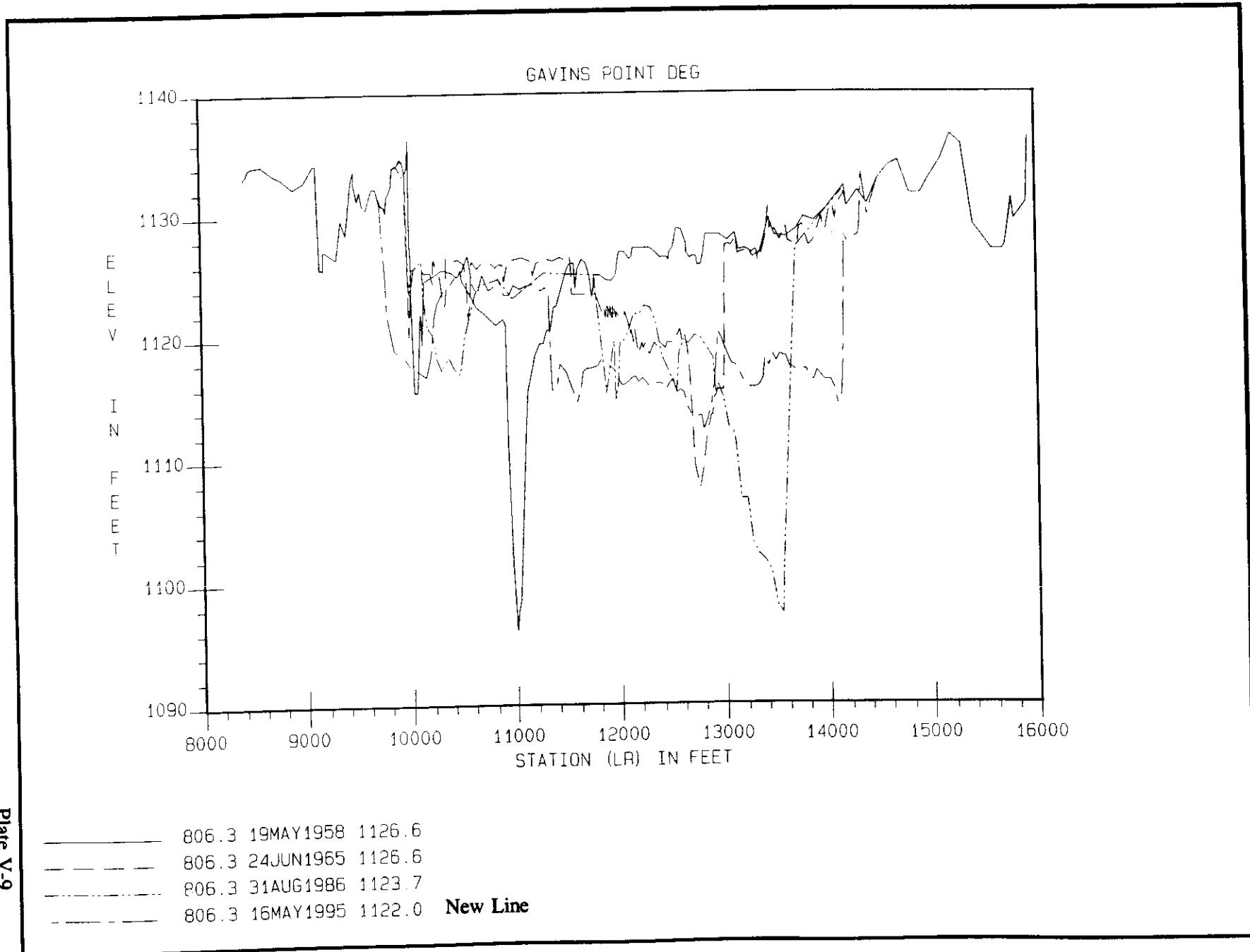
797.5 28JUN1965 1117.7

797.5 07SEP1980 1112.0

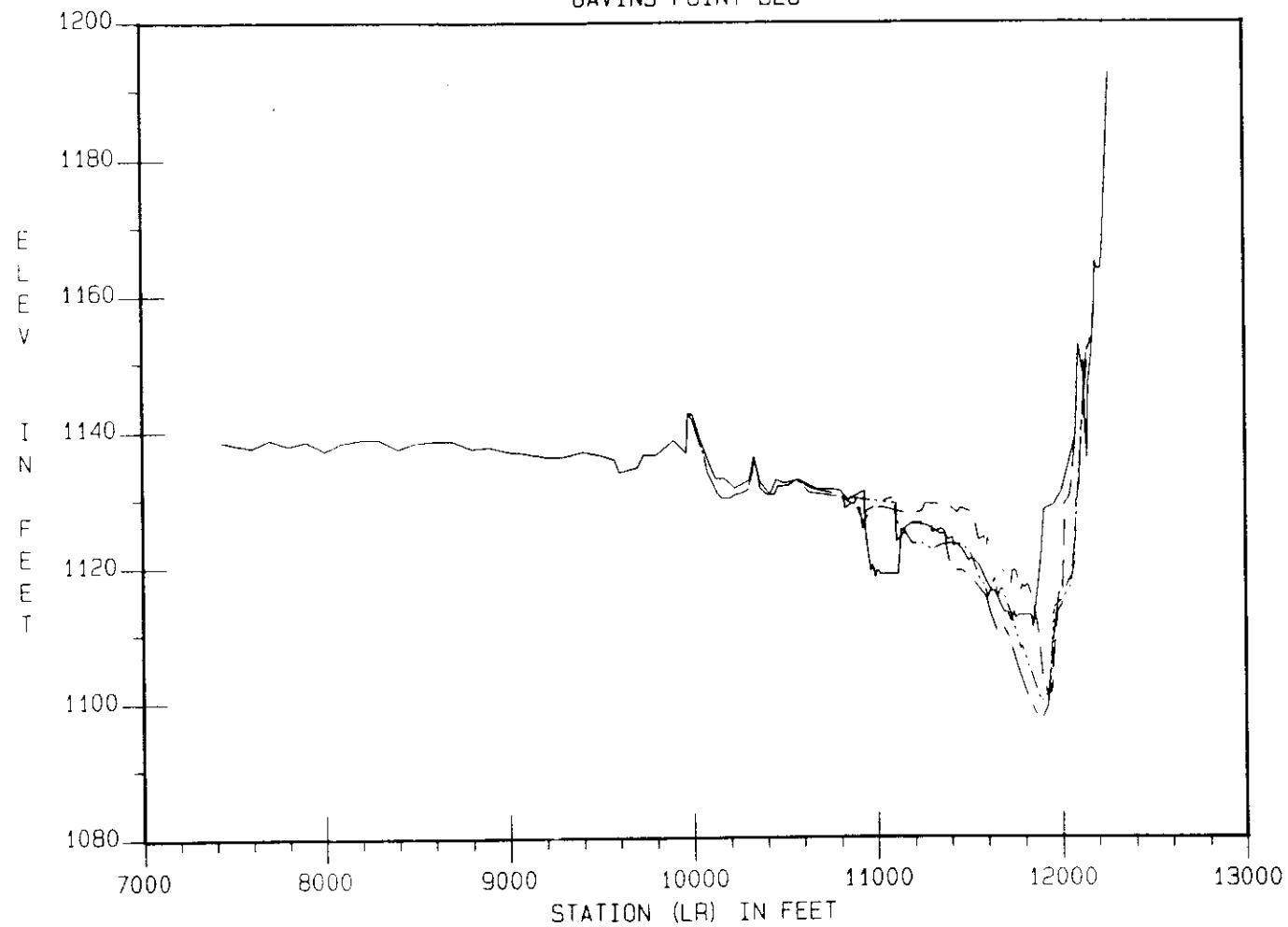
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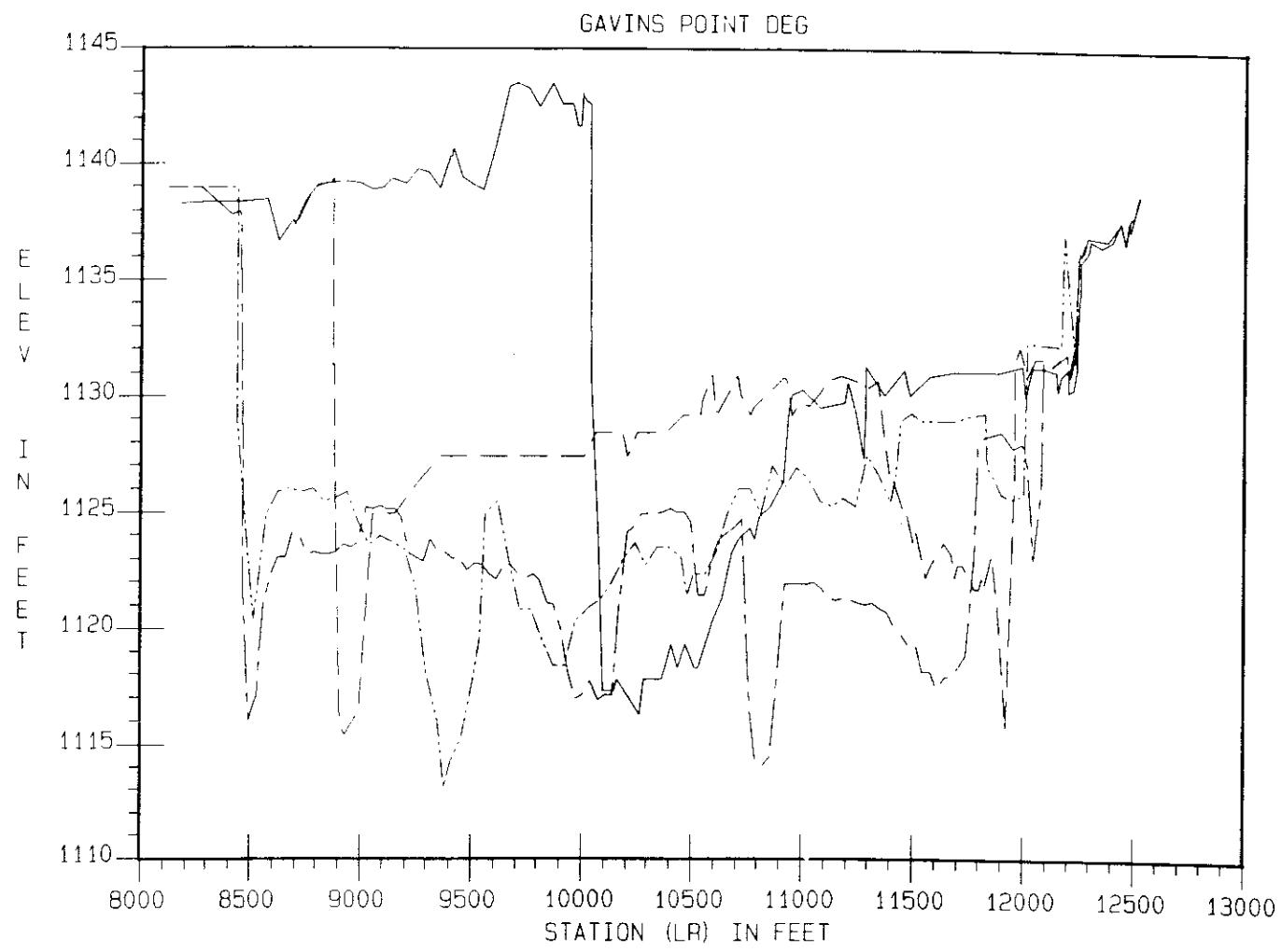


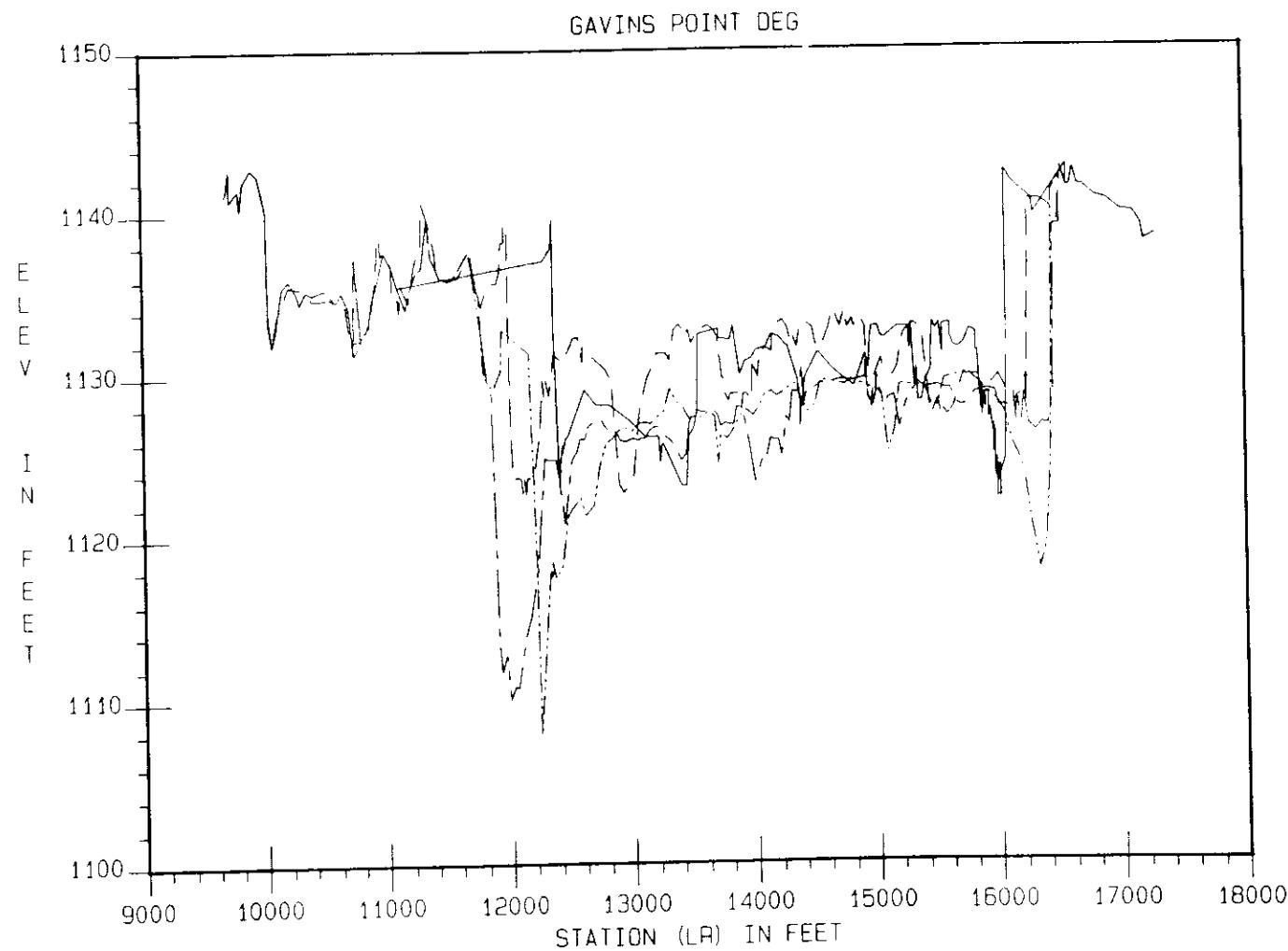


GAVINS POINT DEG

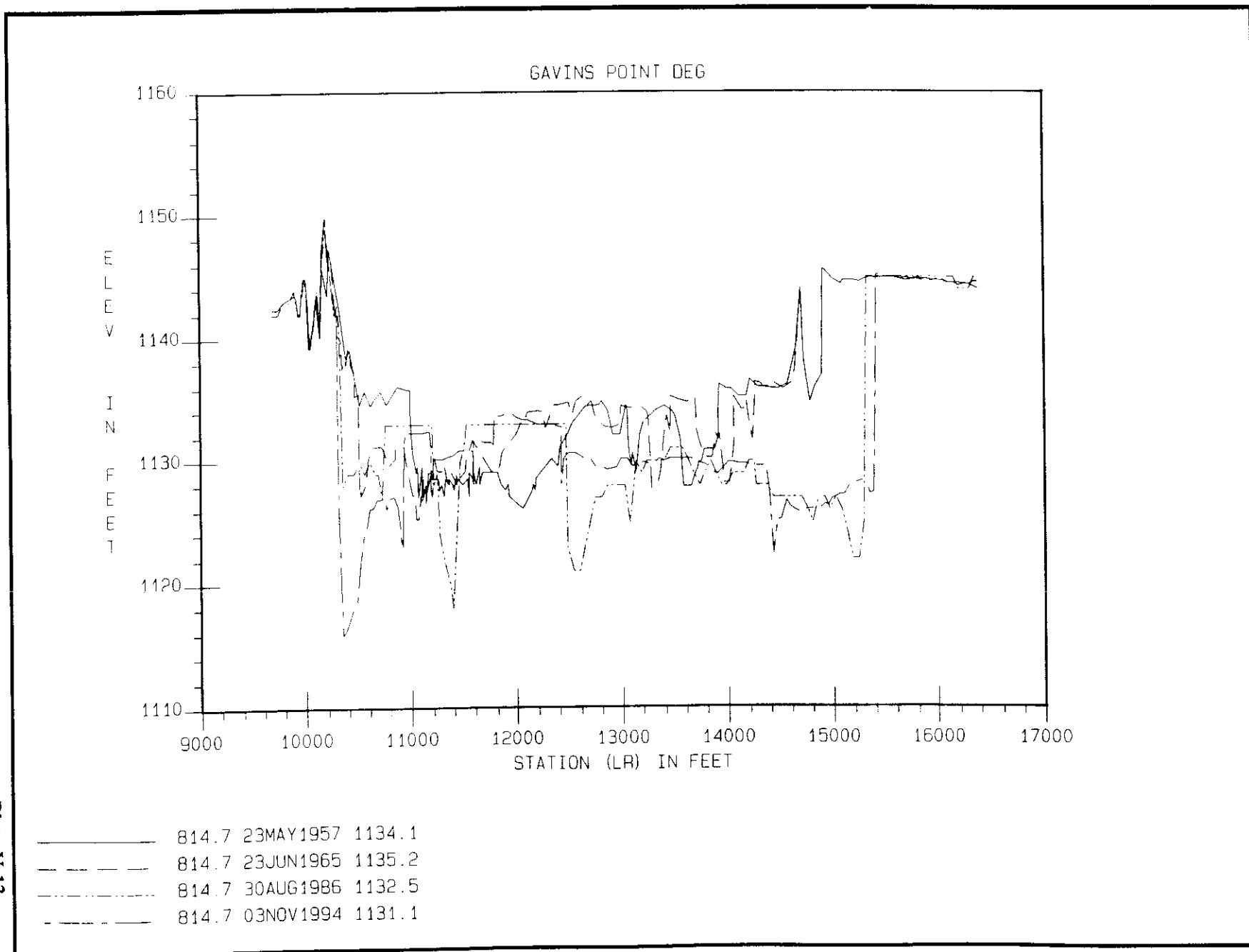


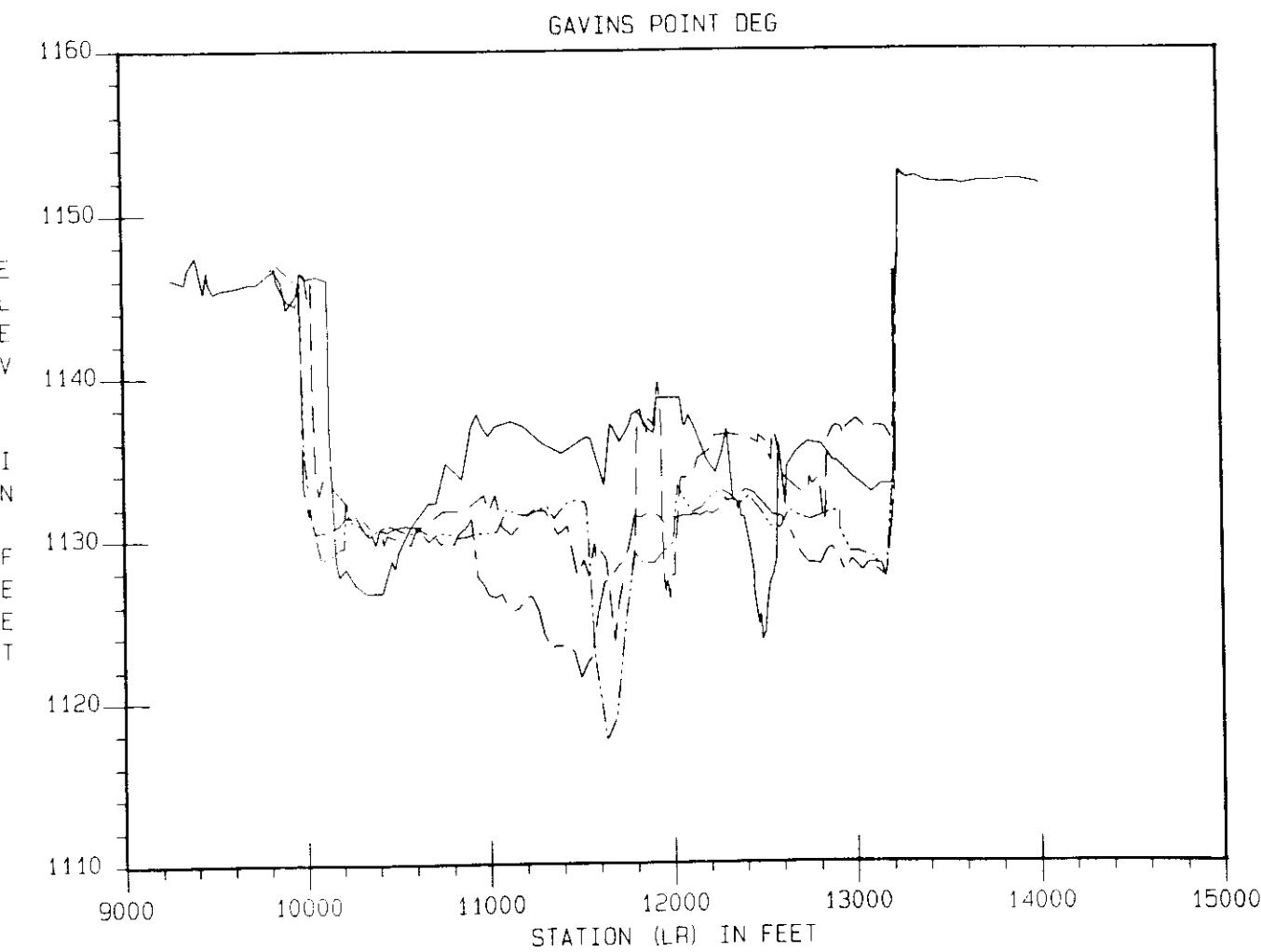
\_\_\_\_ 808.5 24MAY1957 1128.4  
— 808.5 24JUN1965 1129.4  
- - - 808.5 31AUG1986 1127.1  
- - - 808.5 06NOV1994 1125.0

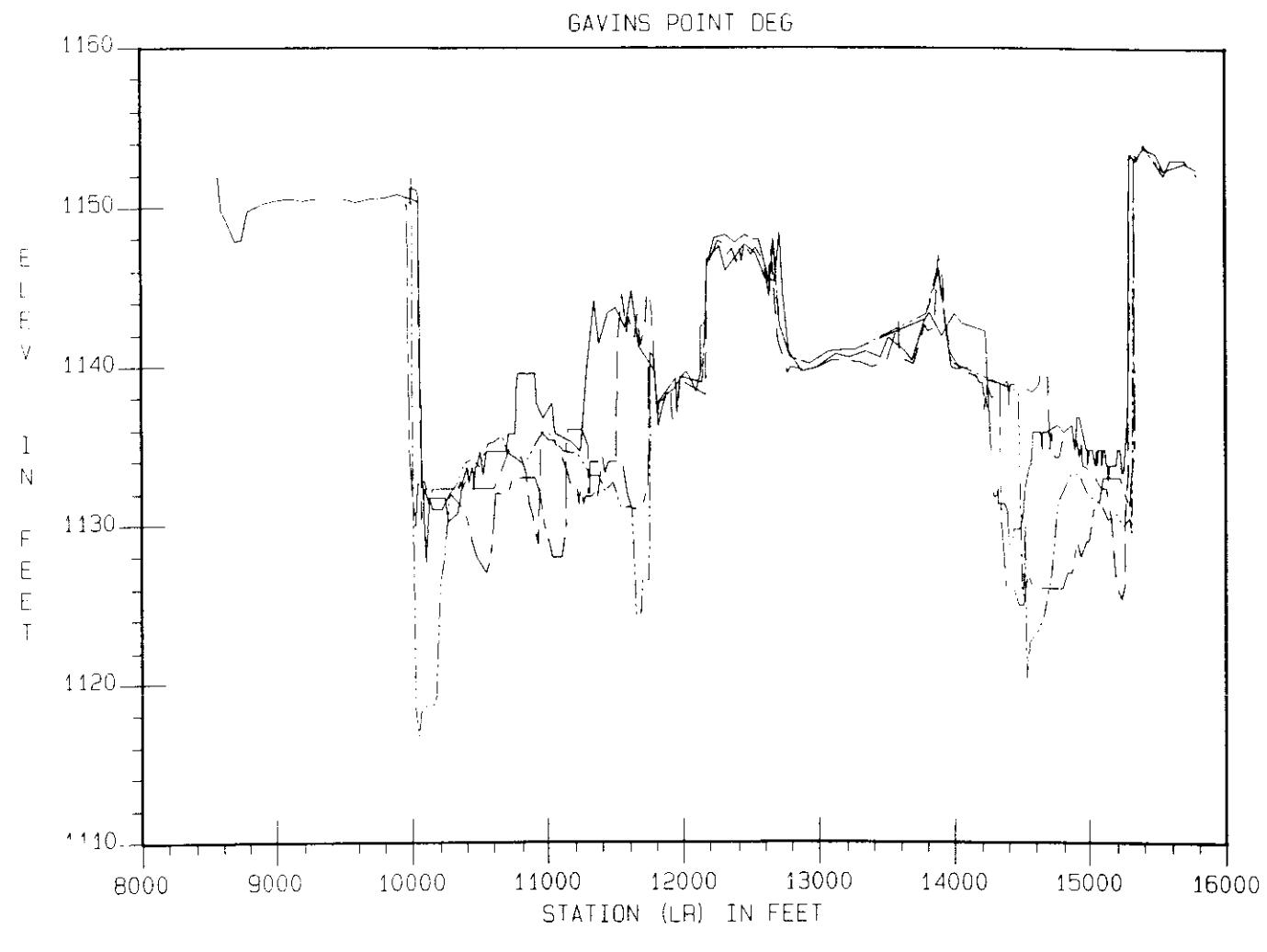


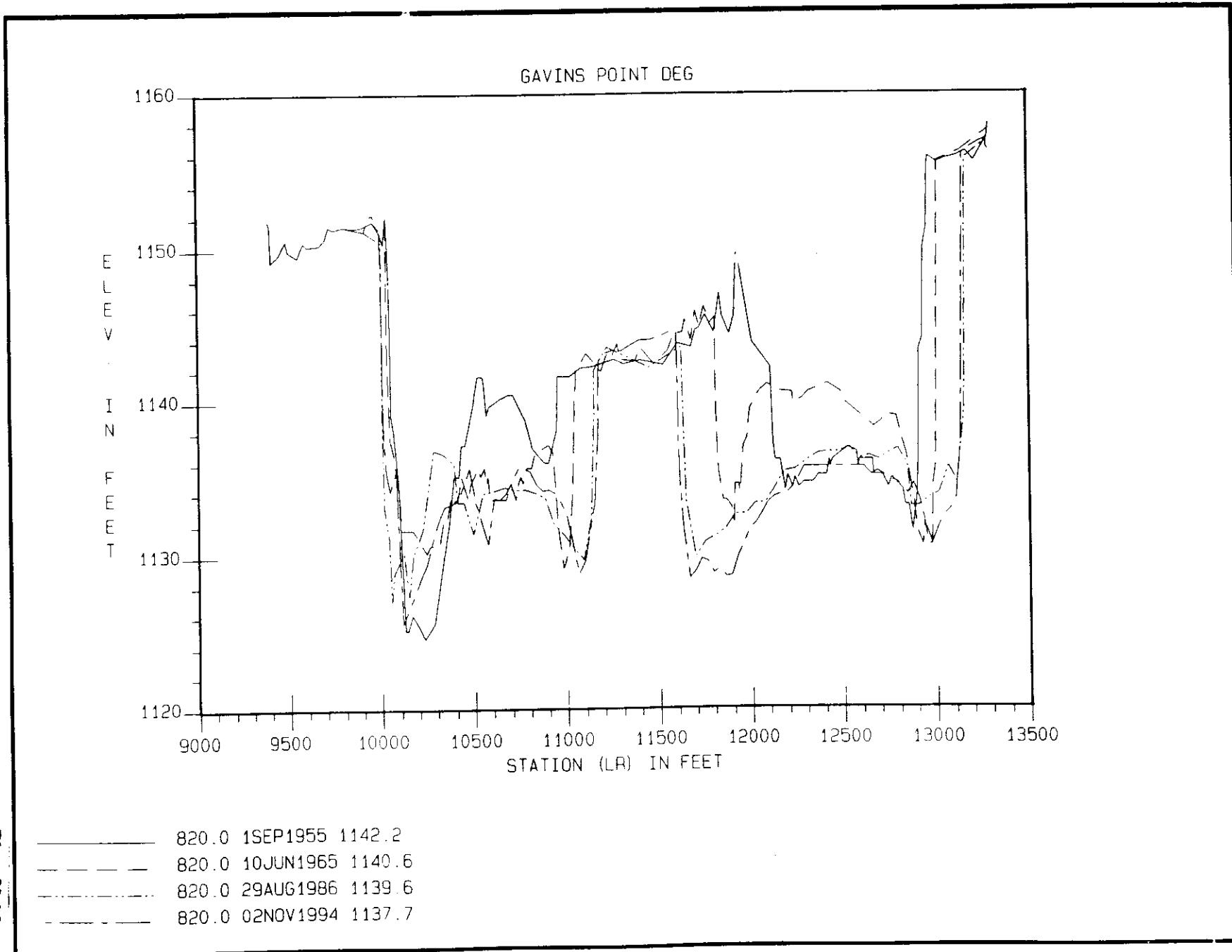


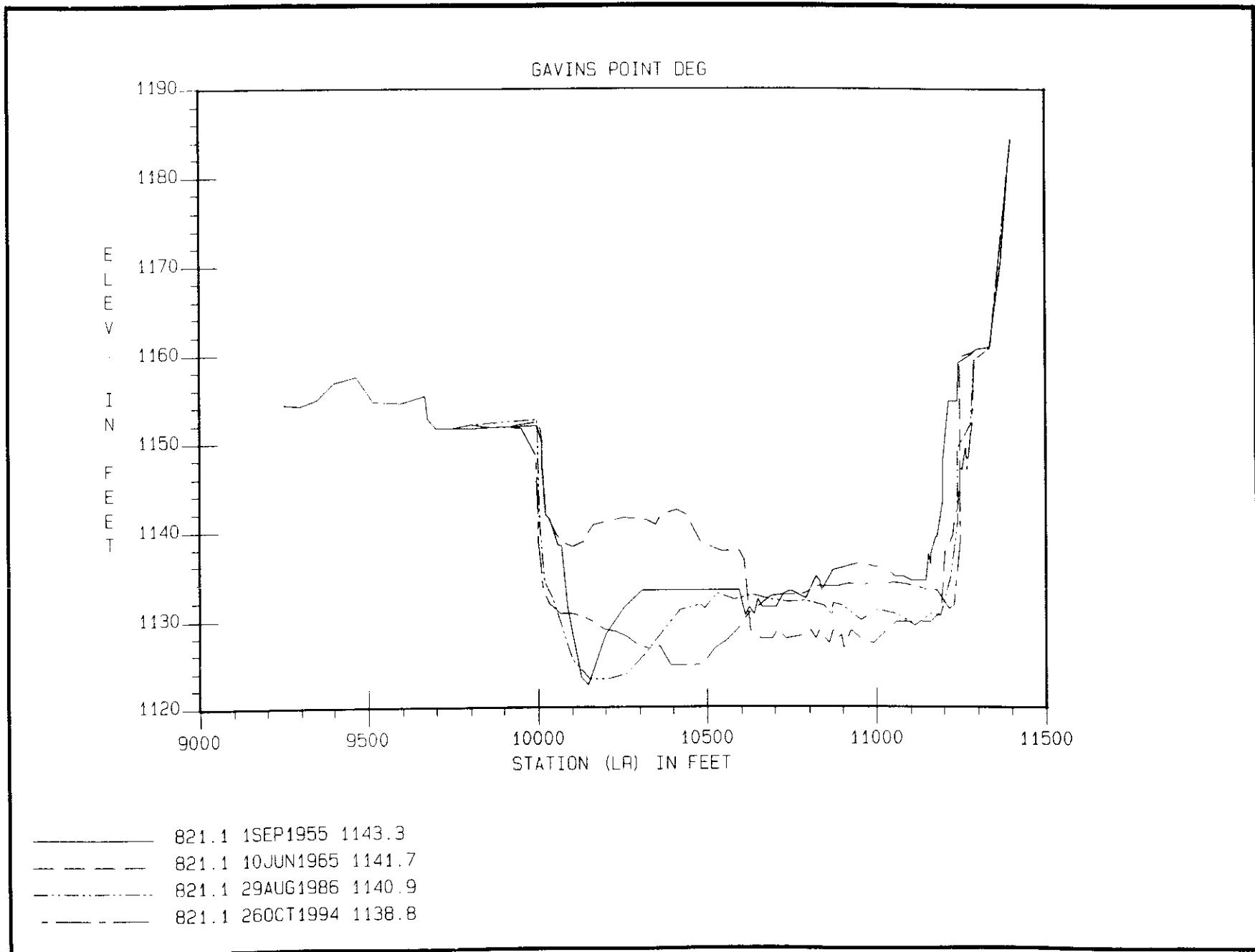
— 812.7 200CT1960 1132.5  
- - - 812.7 23JUN1965 1131.0  
- · - - 812.7 30AUG1986 1130.6  
— · — 812.7 14MAY1995 1128.9

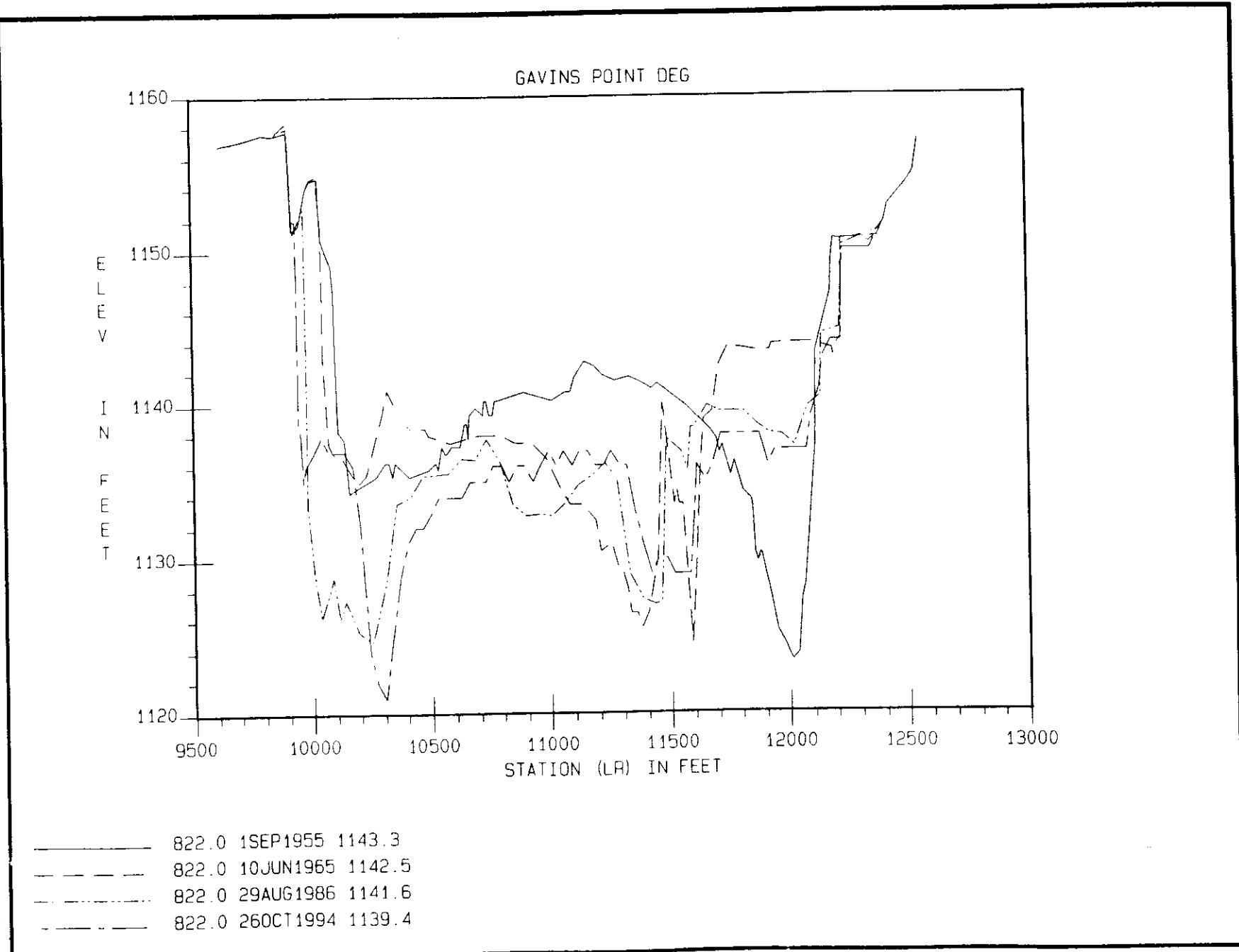


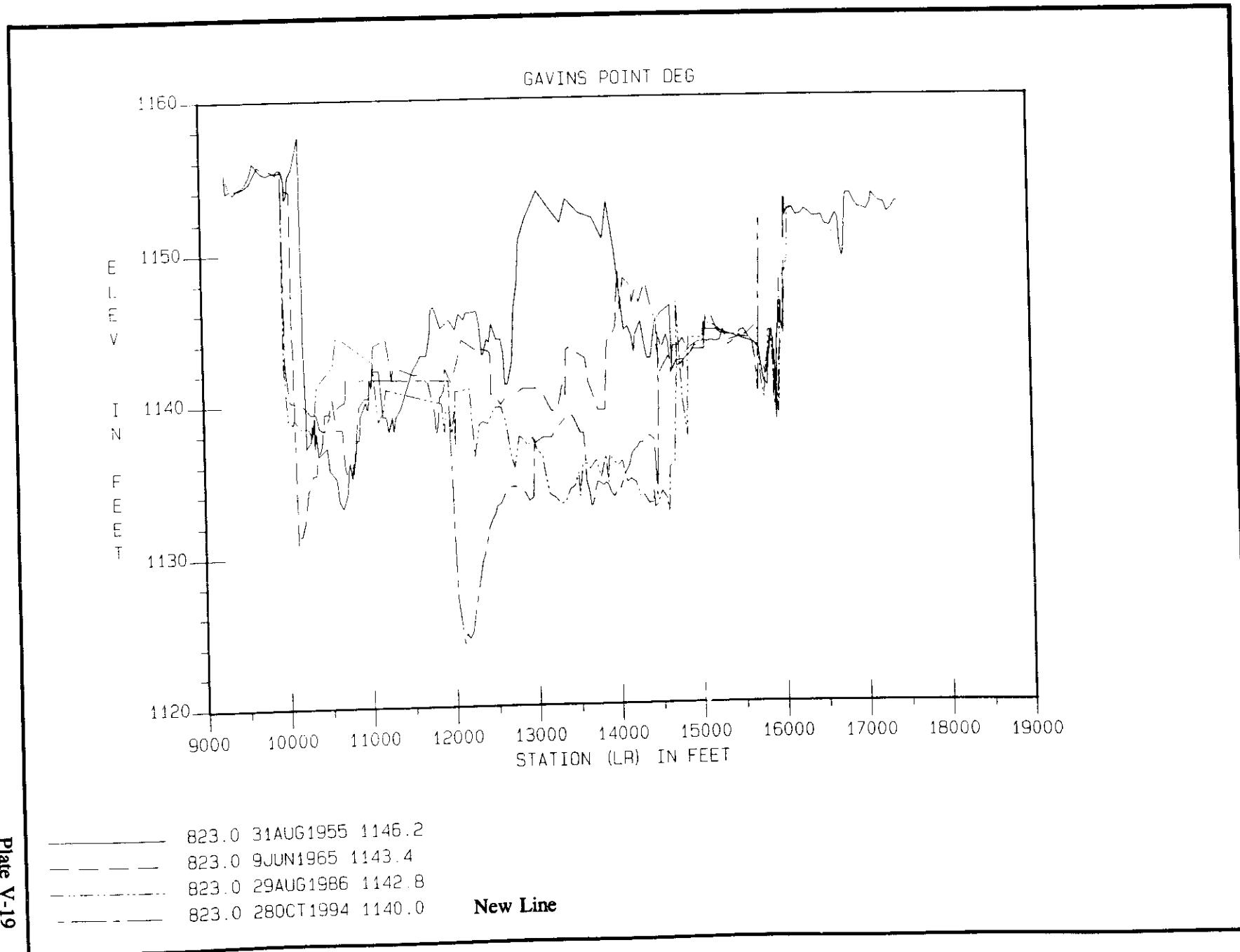


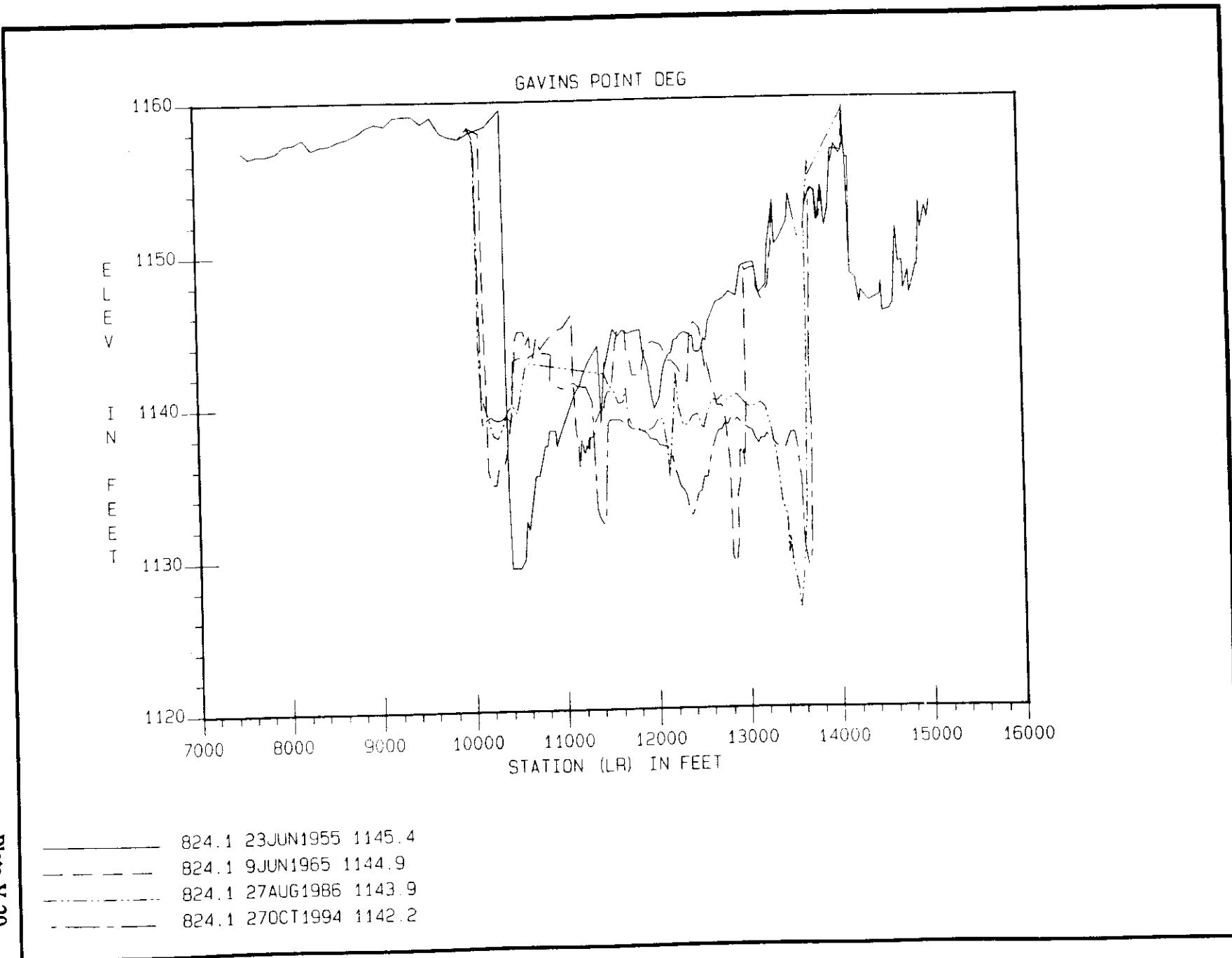


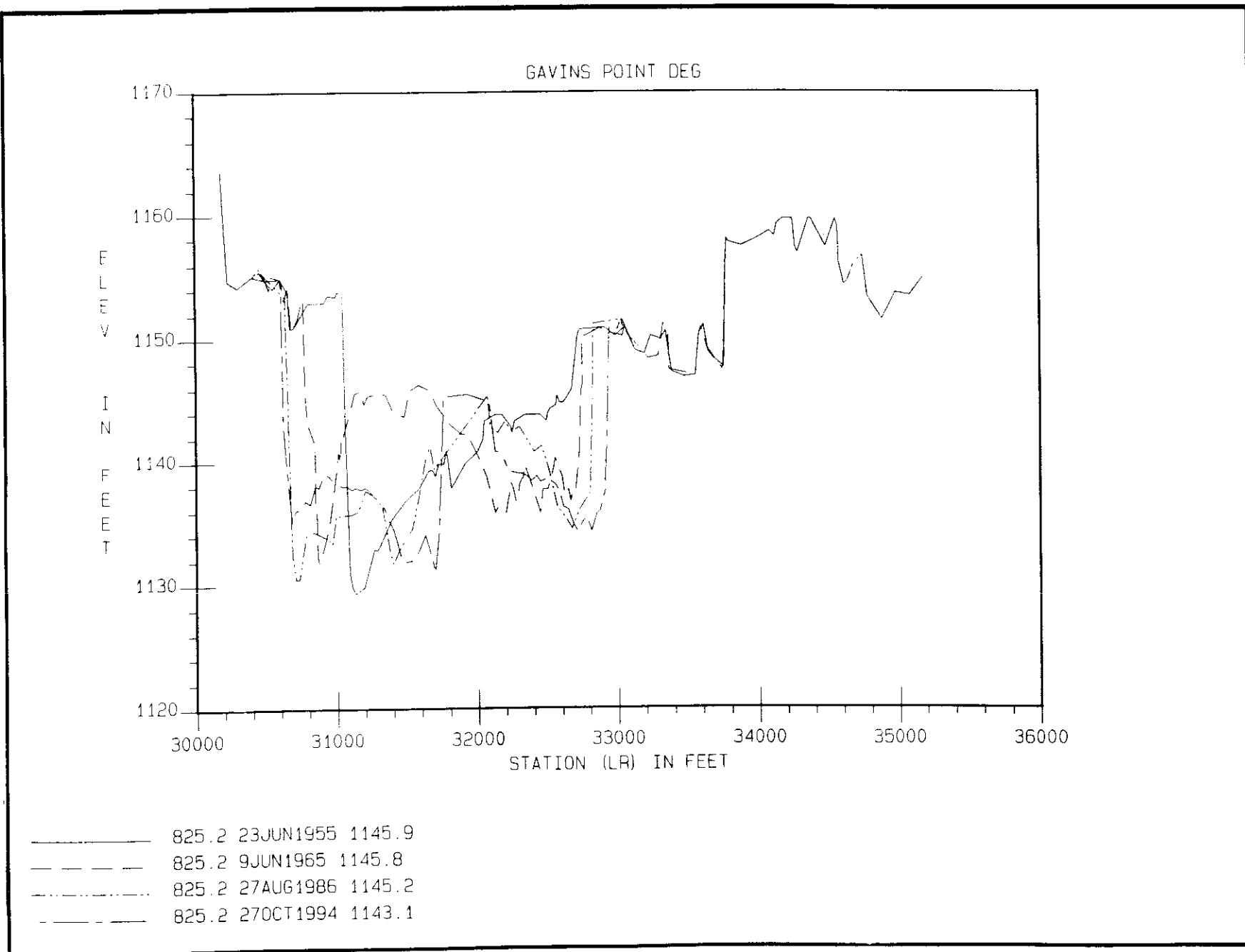


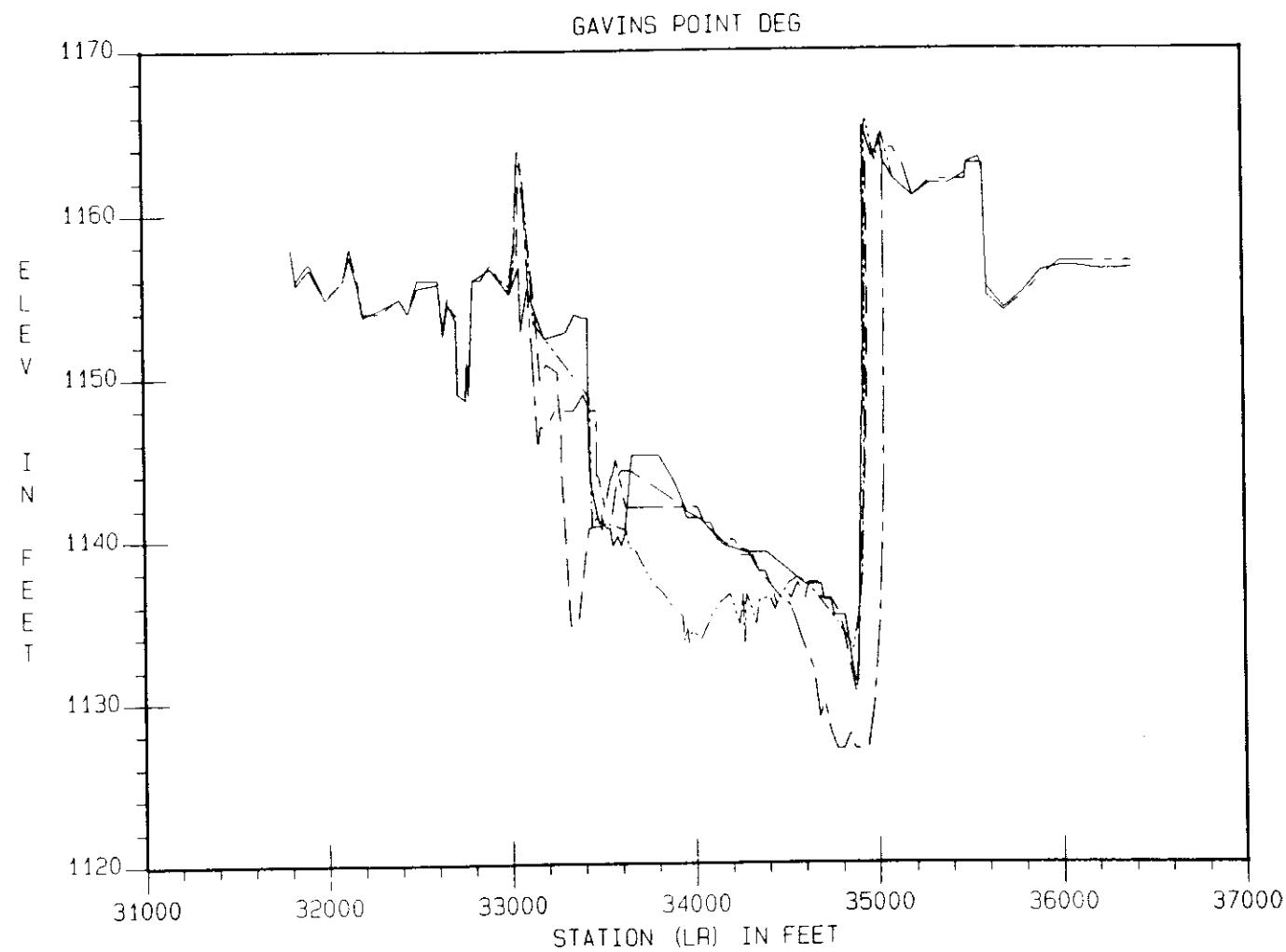


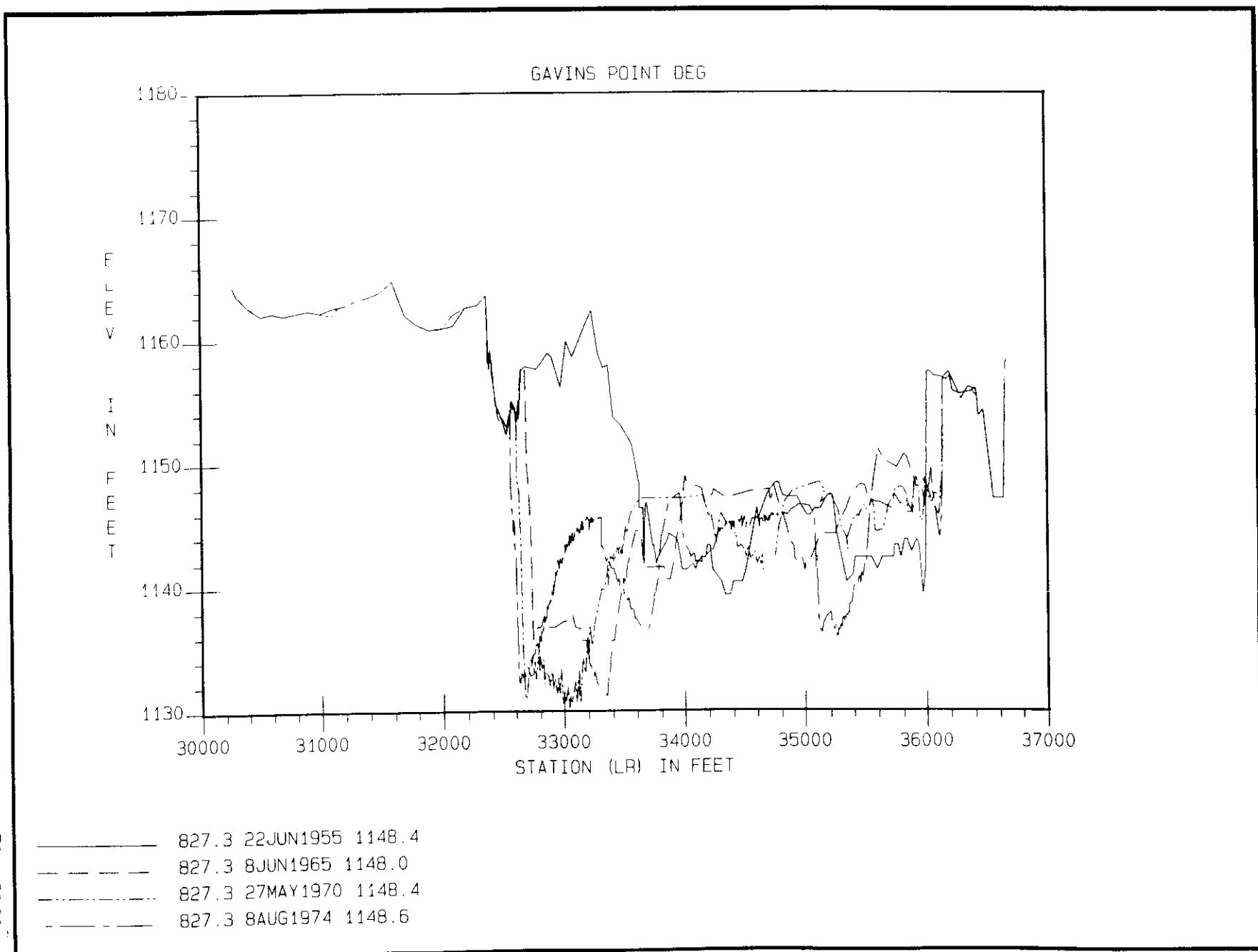


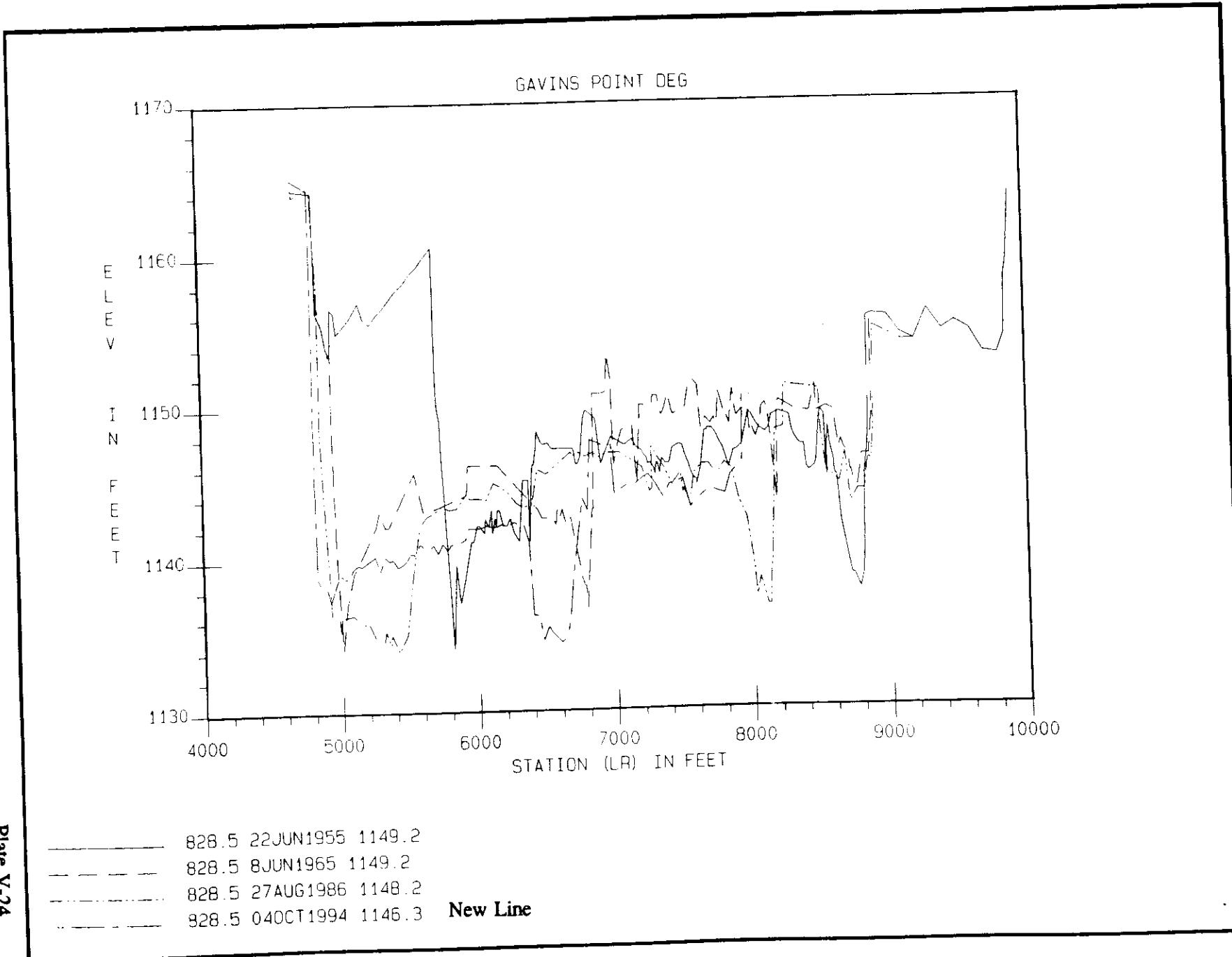


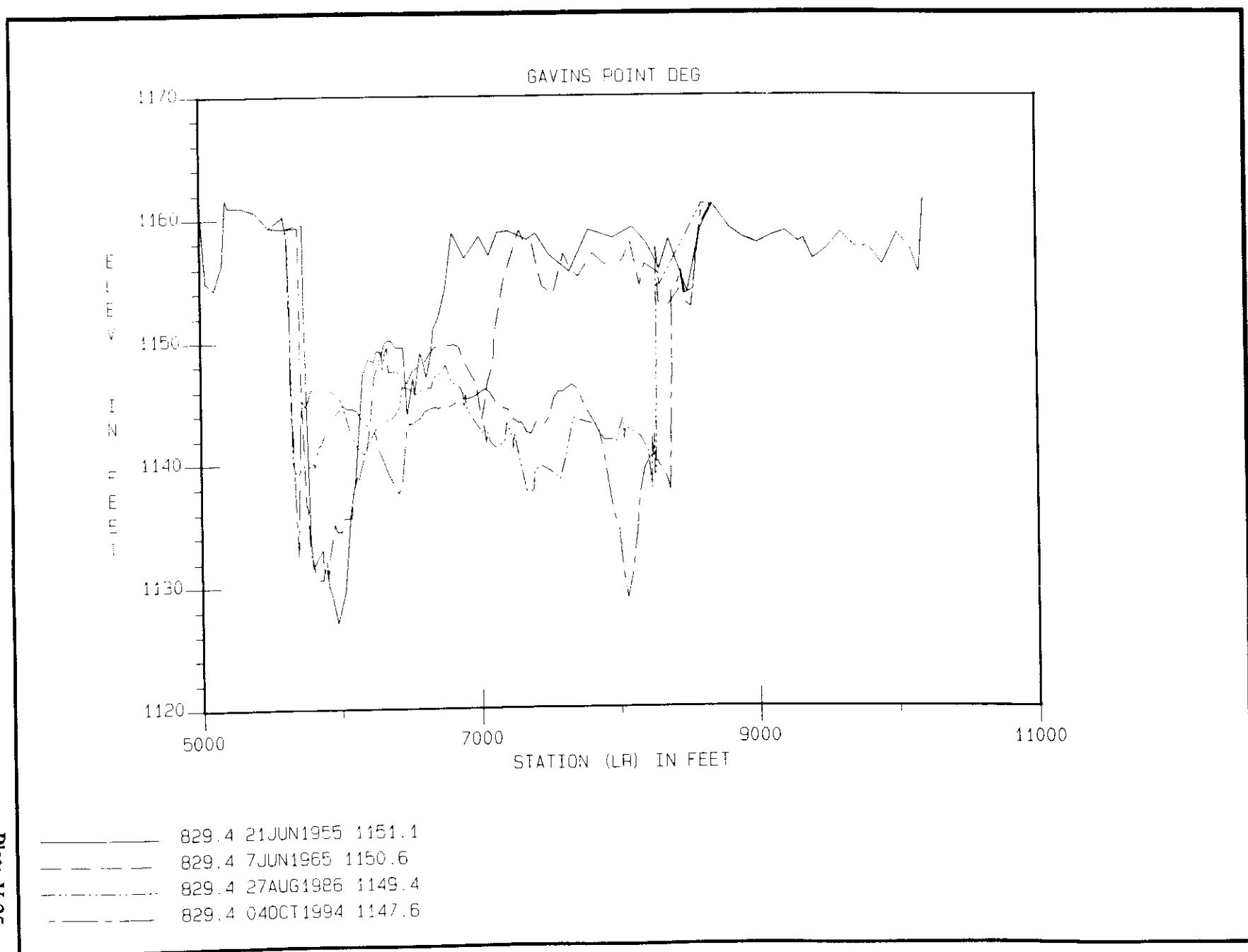


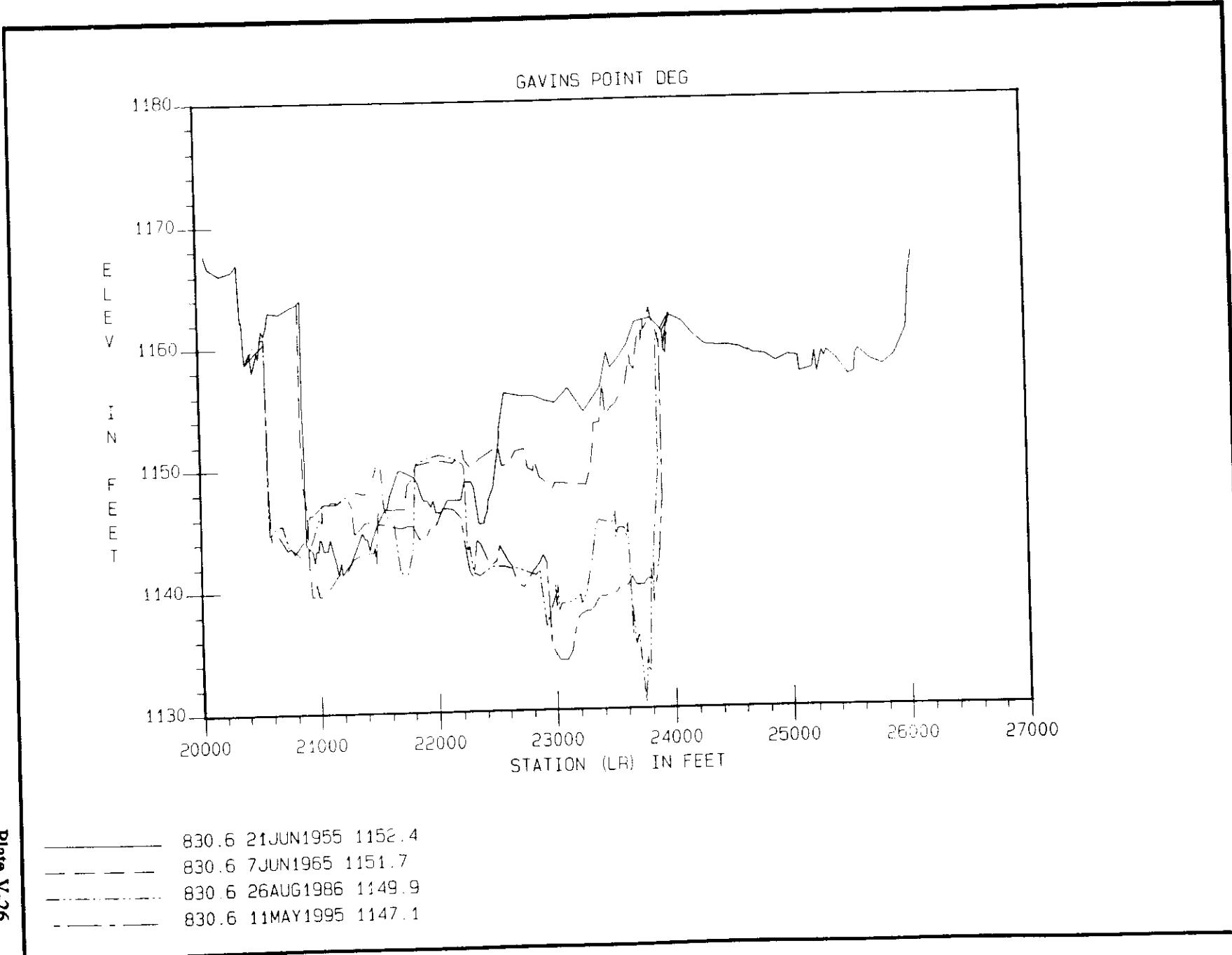


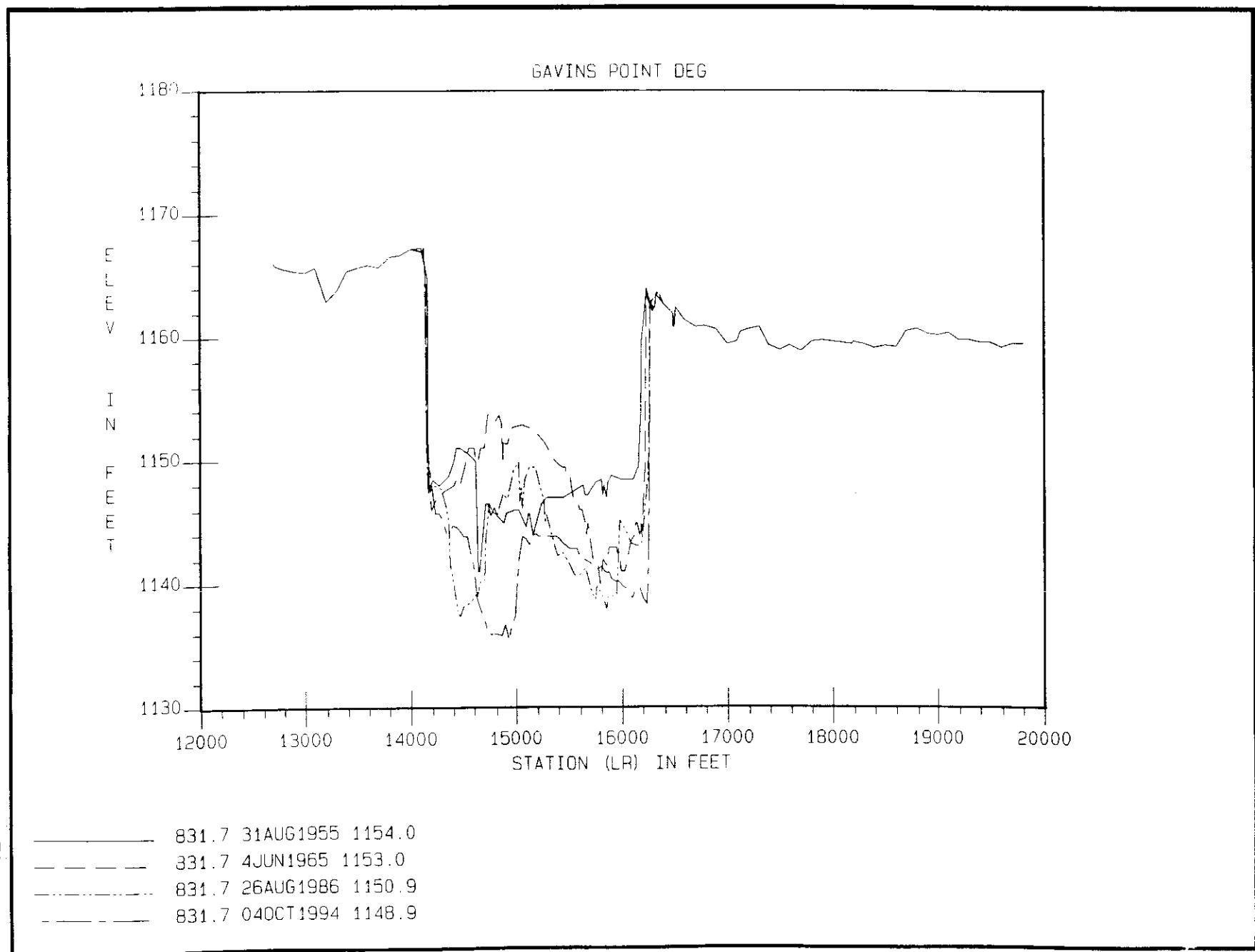


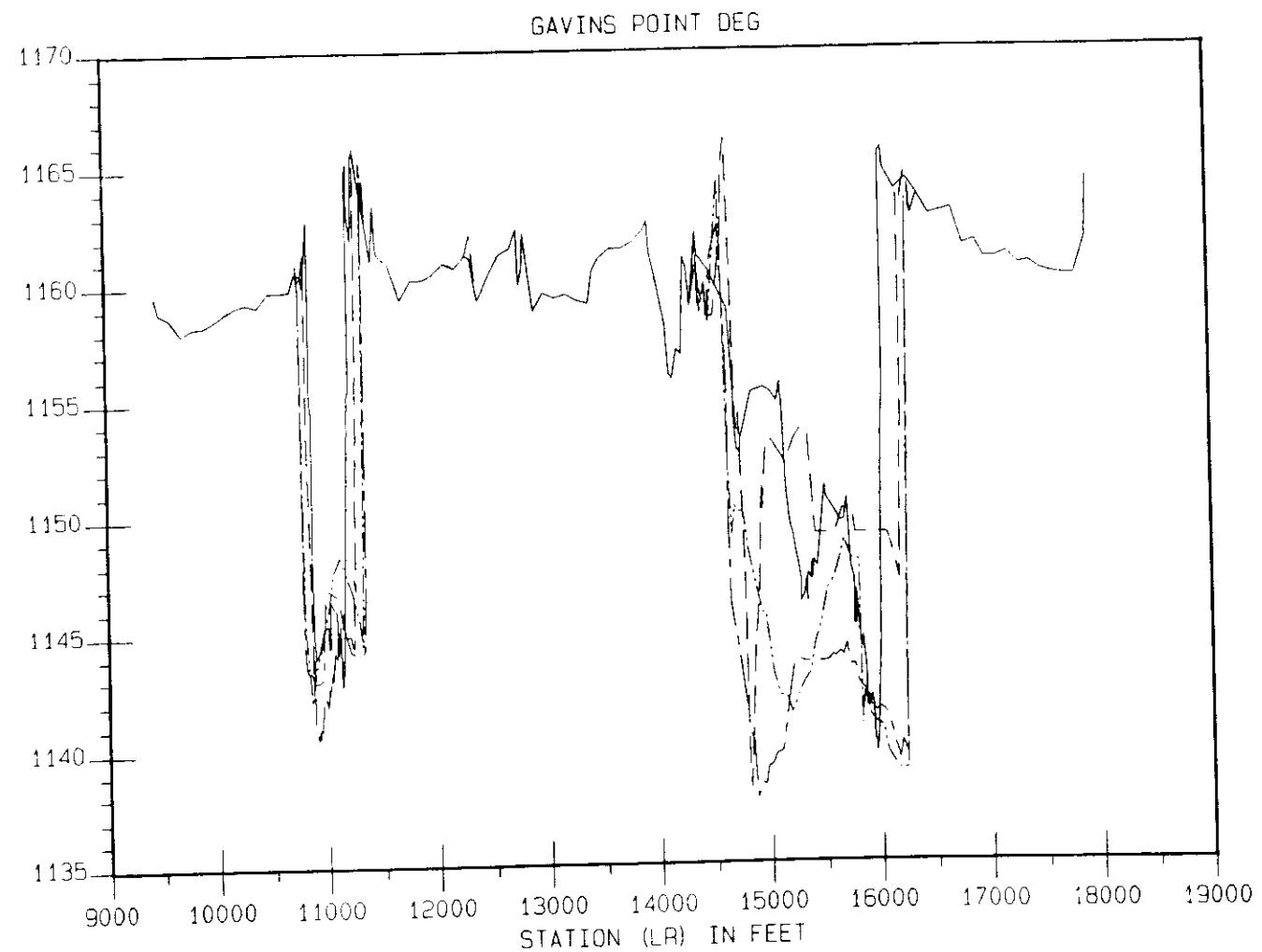


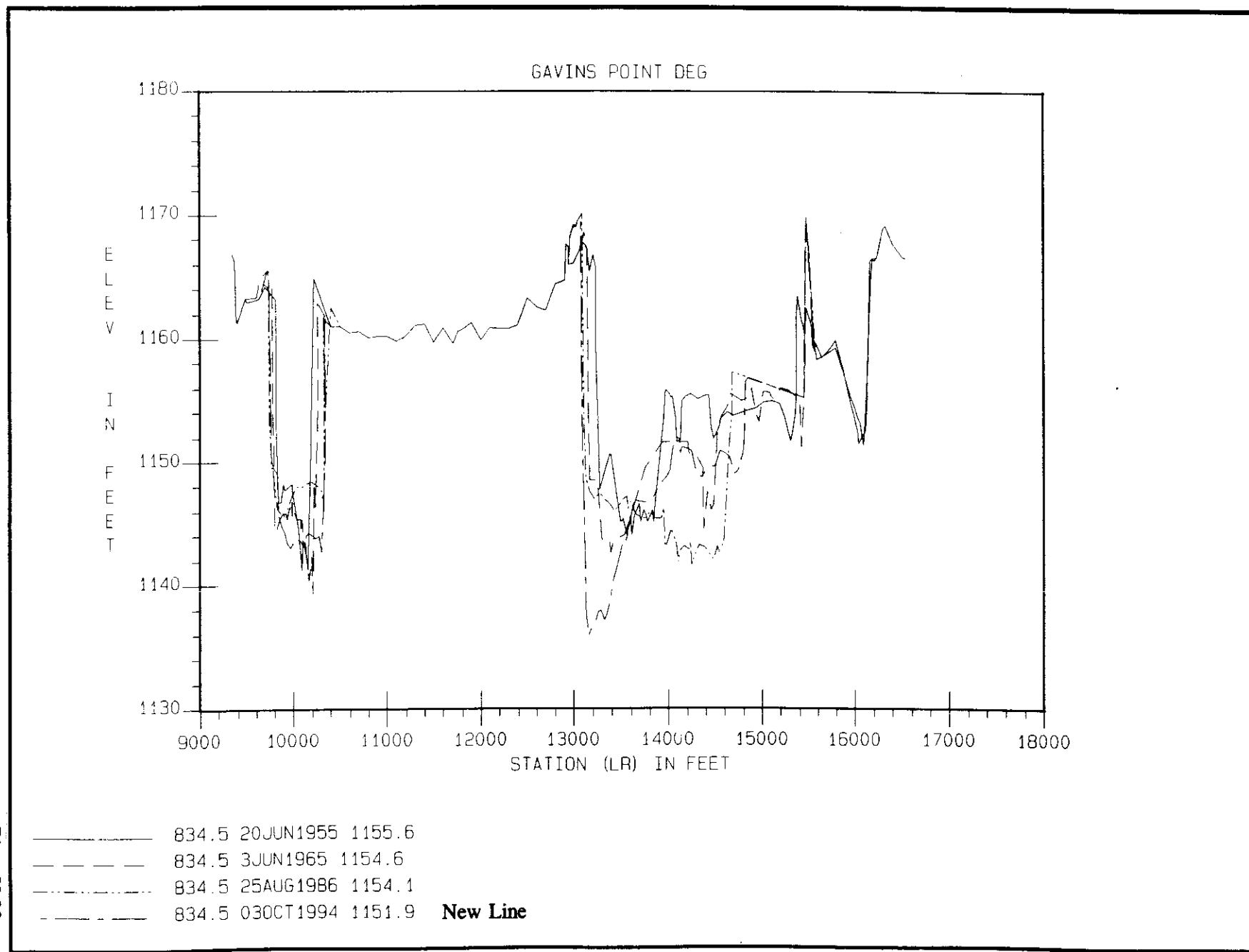


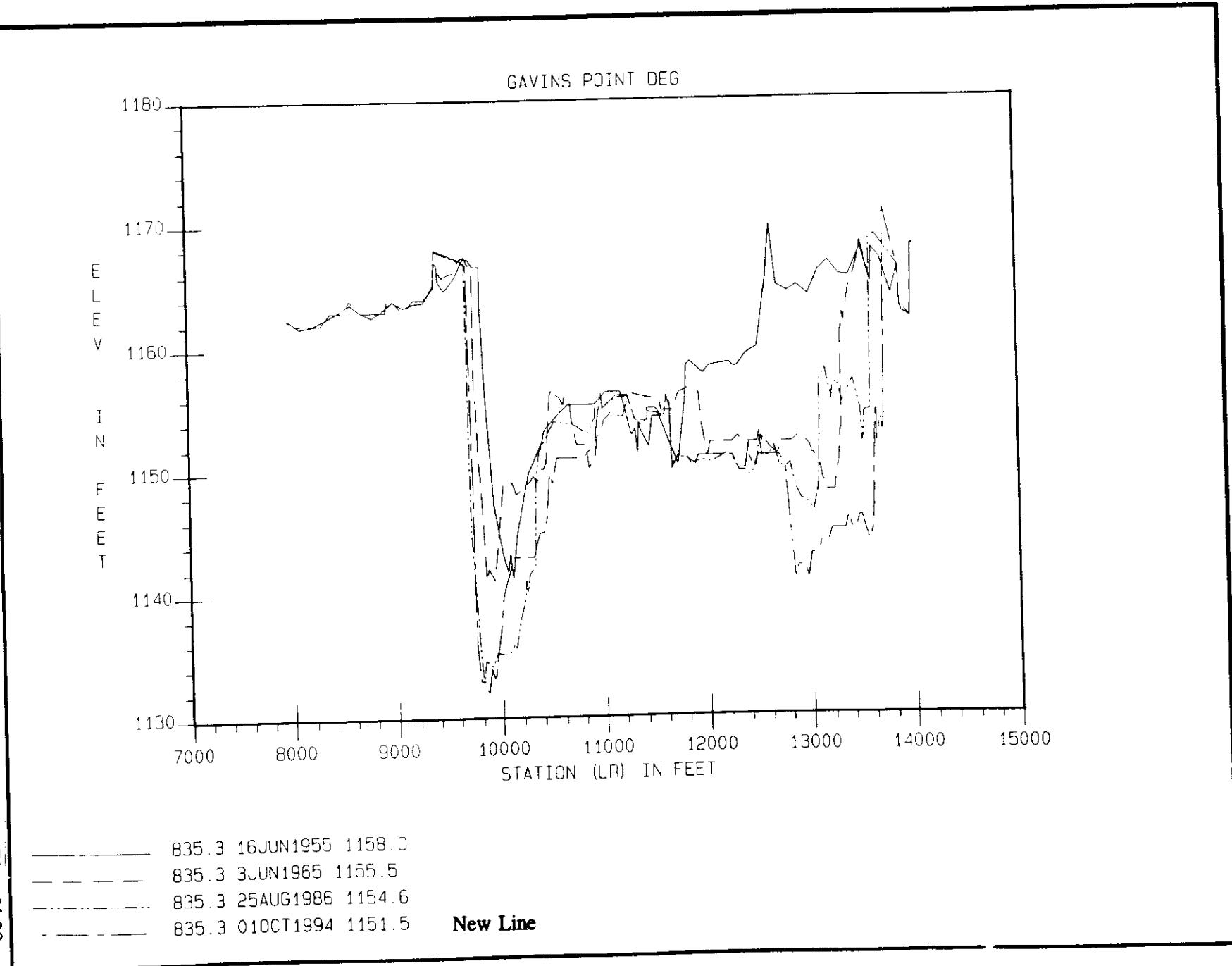


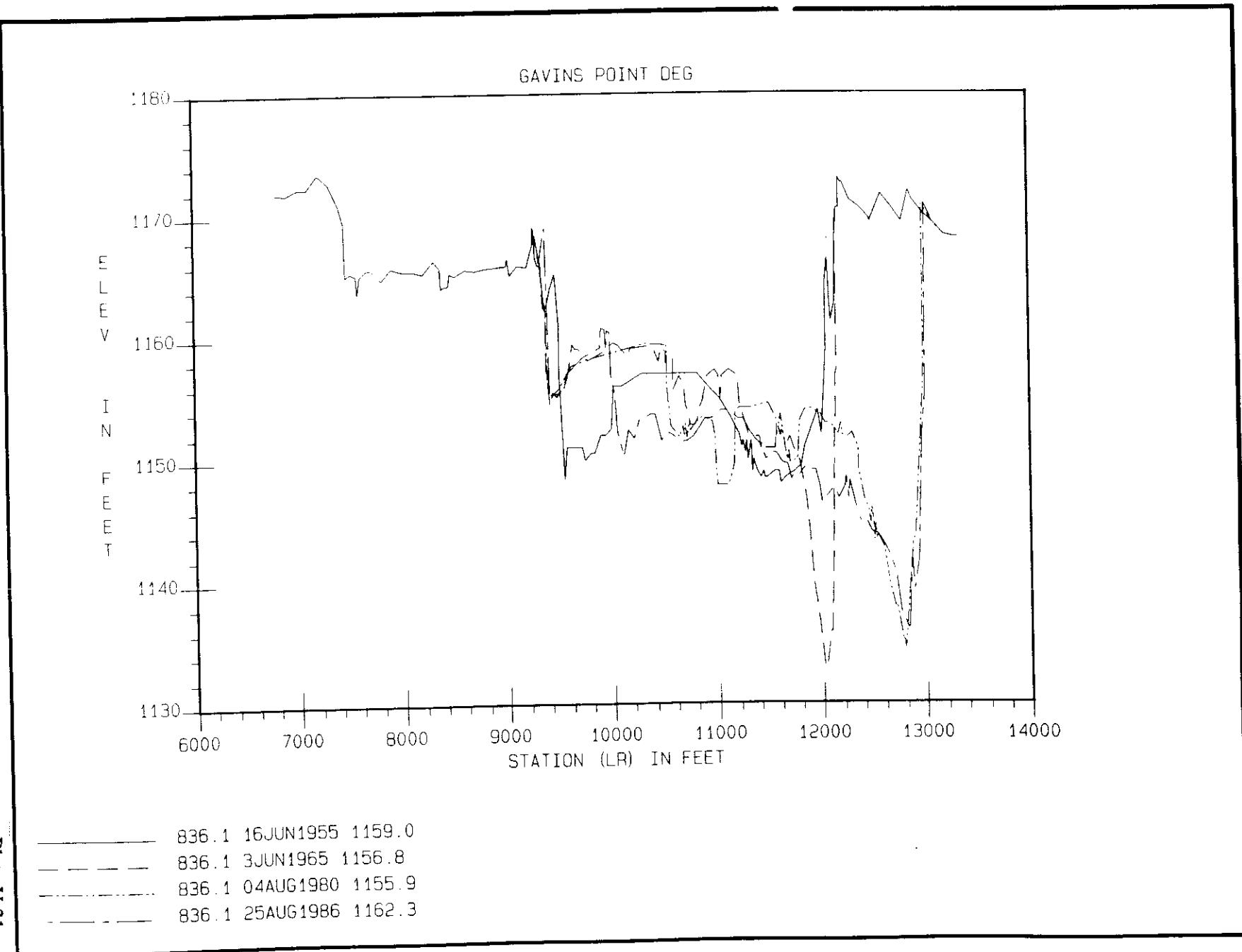




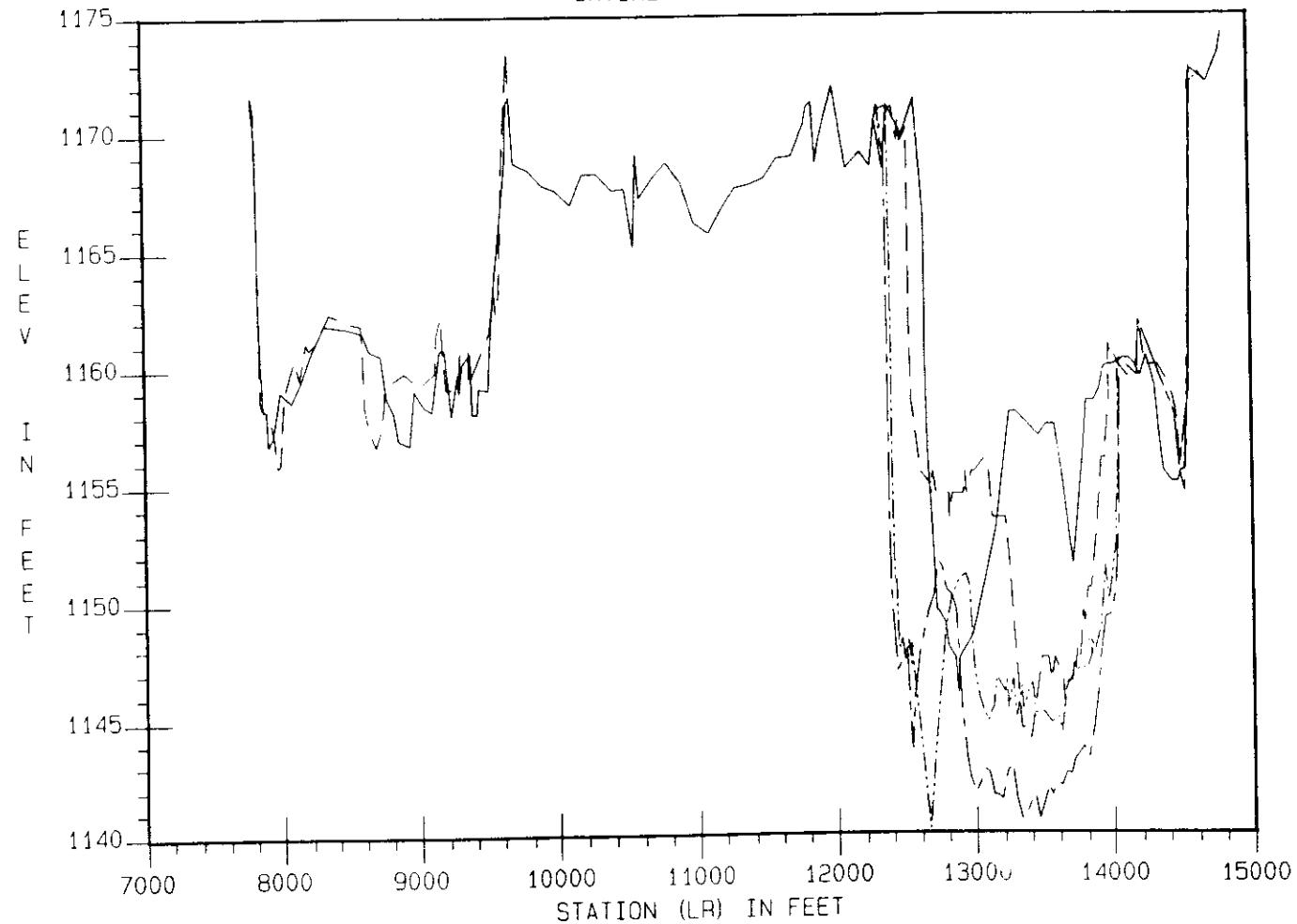


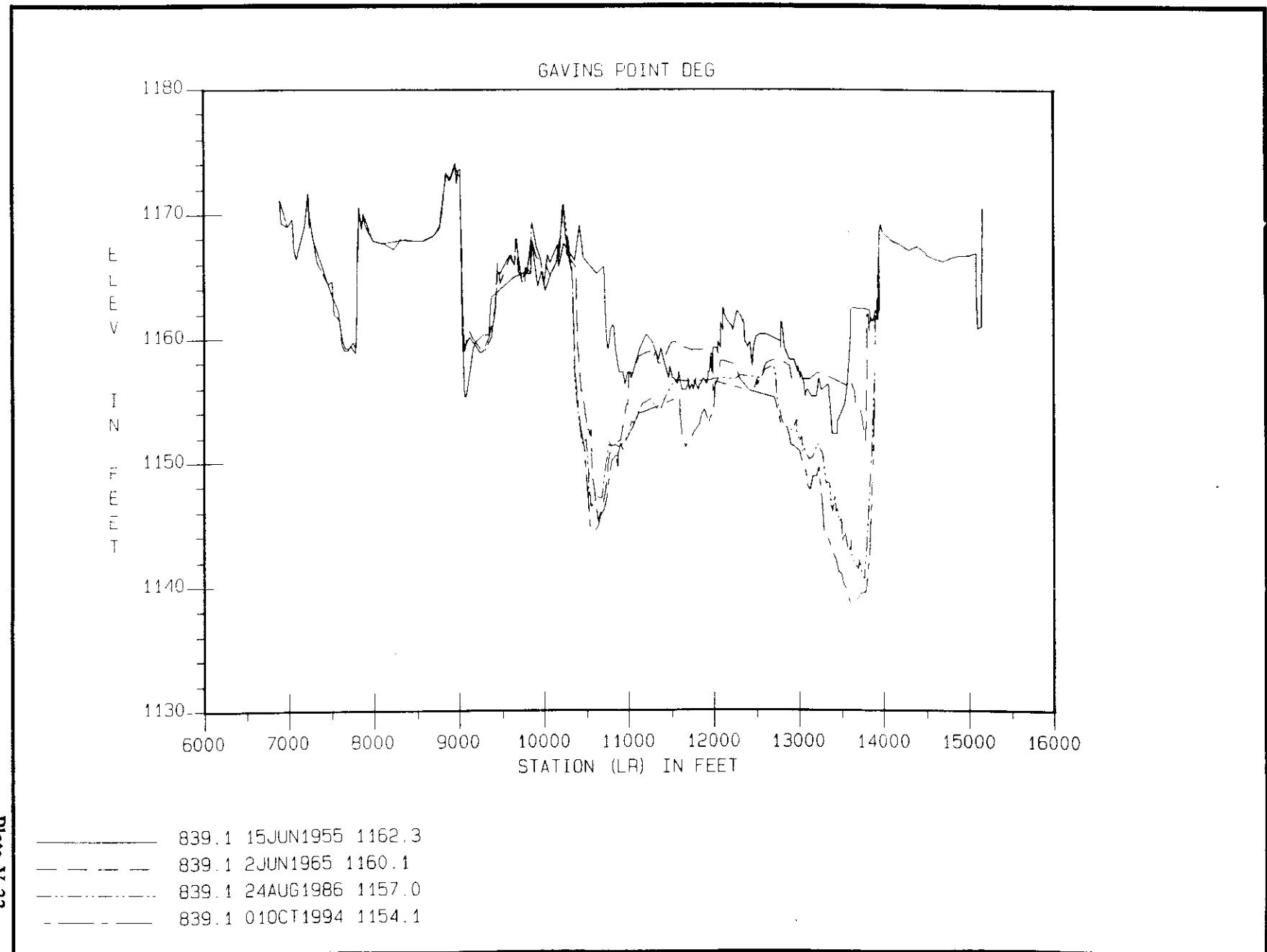


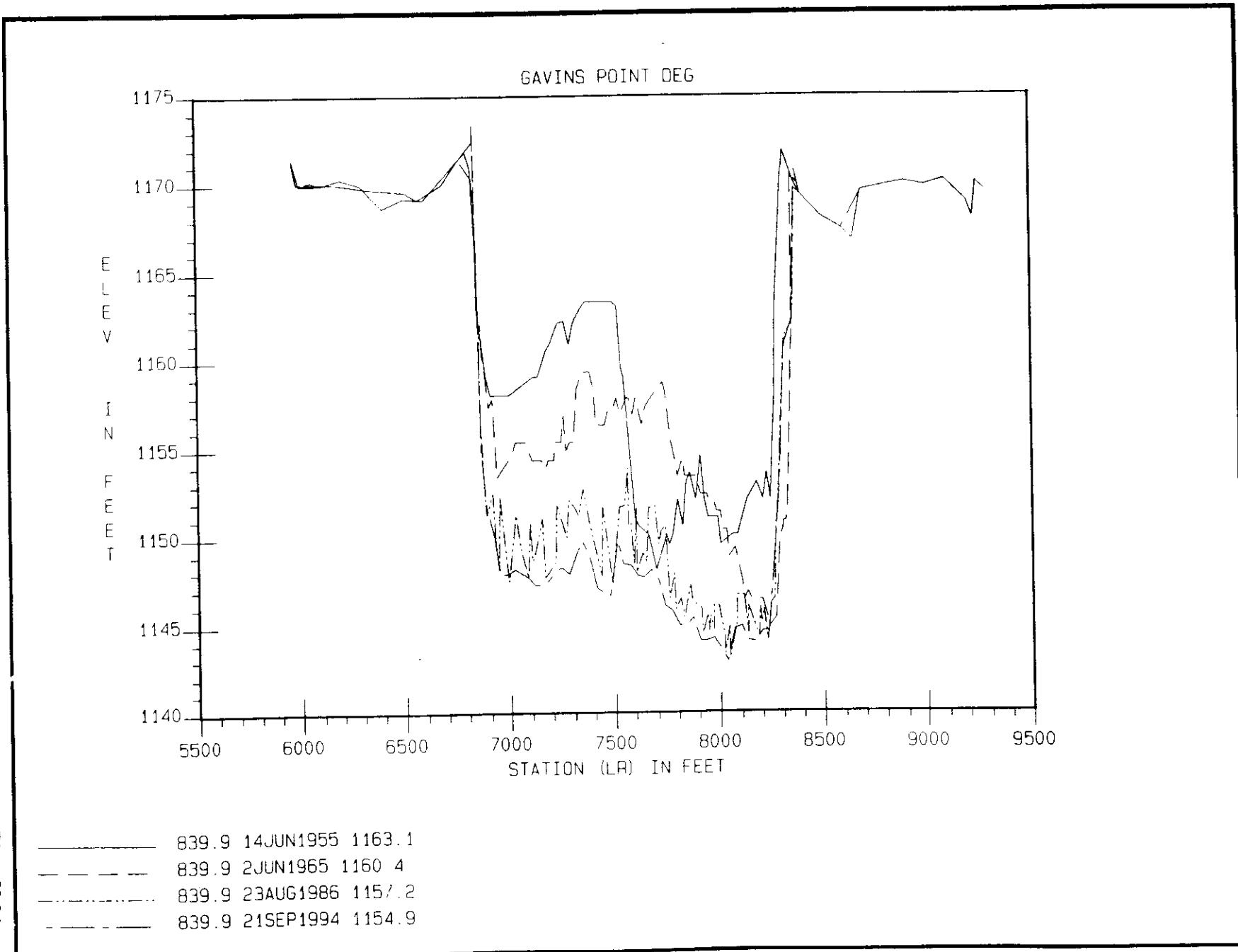


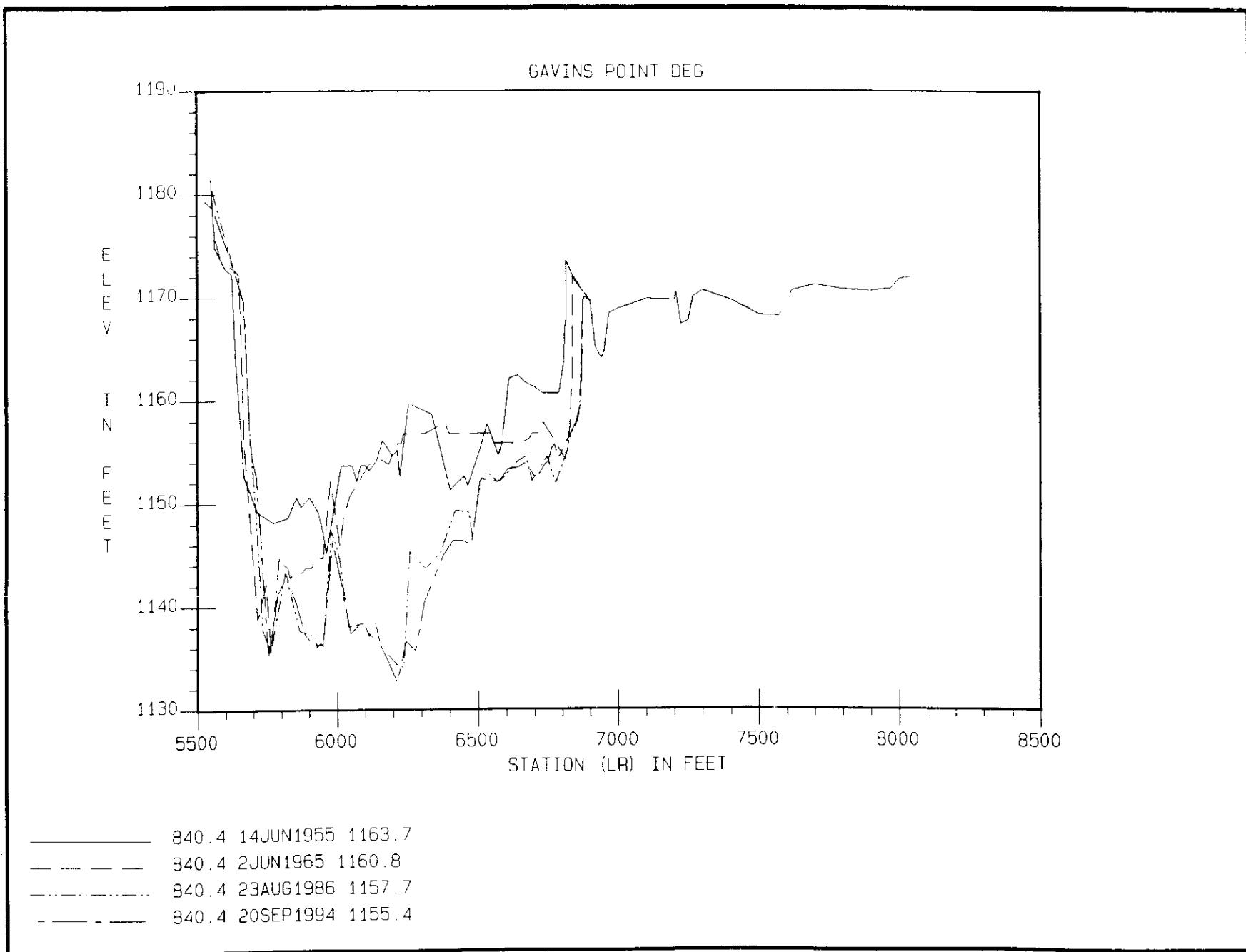


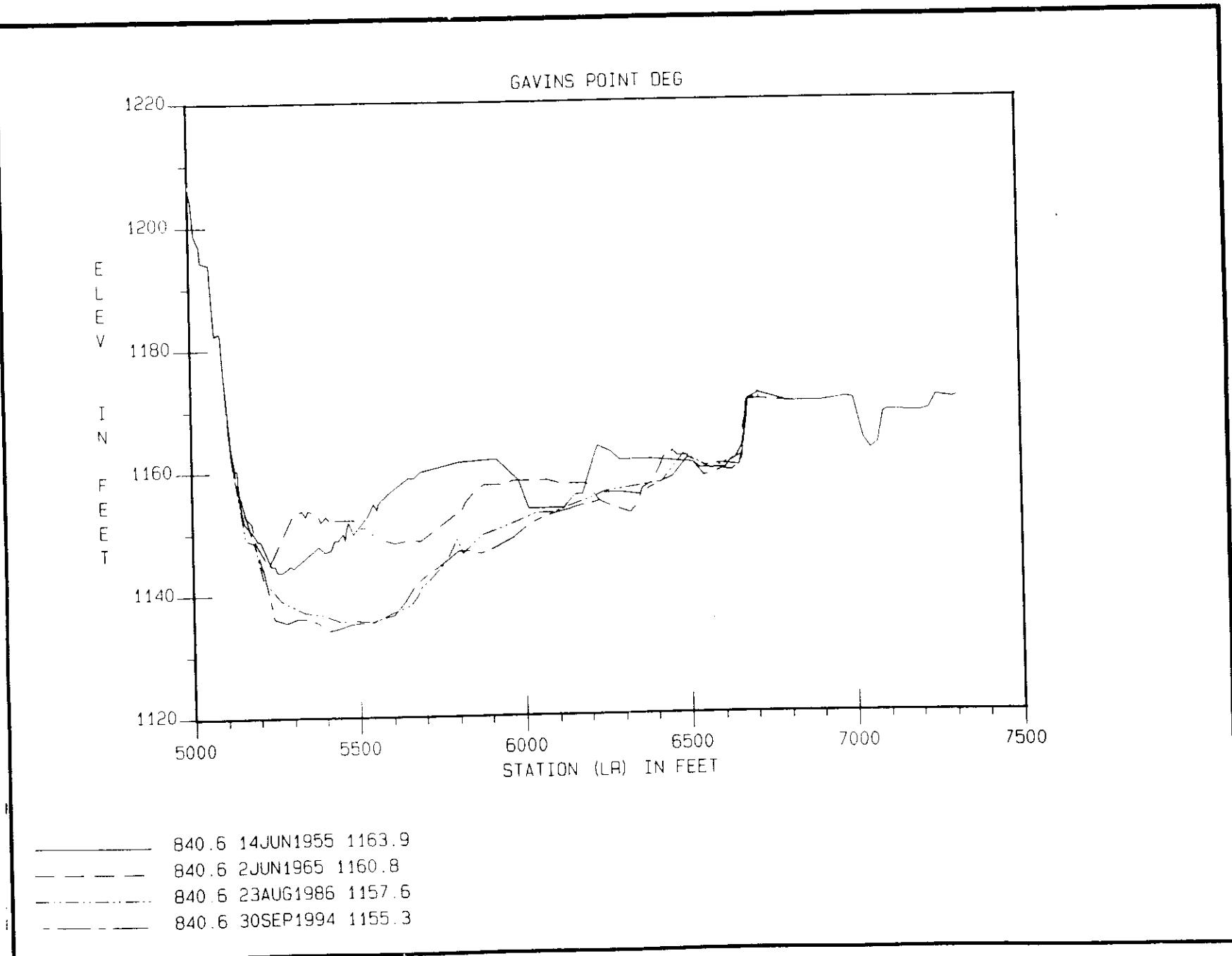
GAVINS POINT DEG

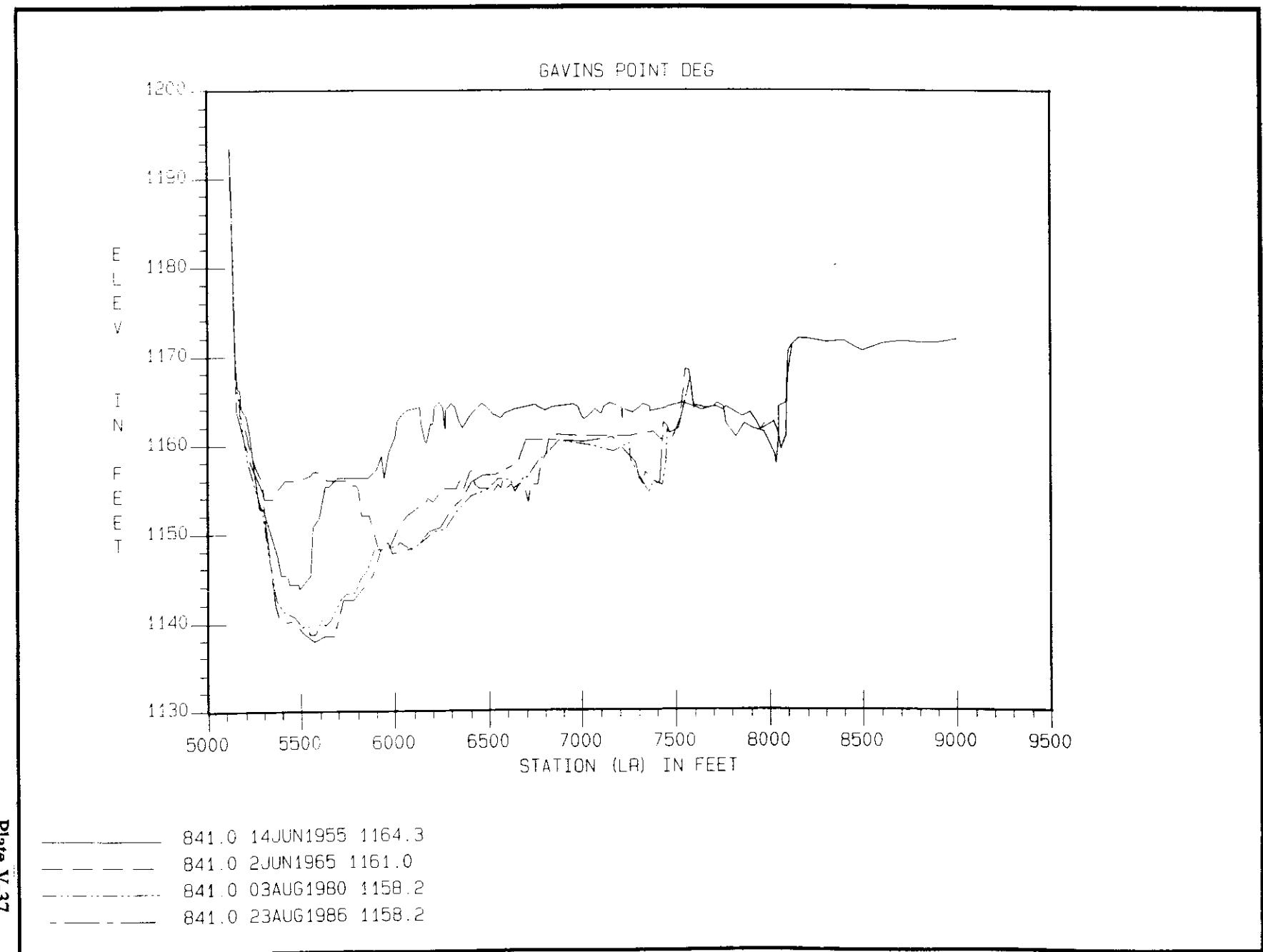




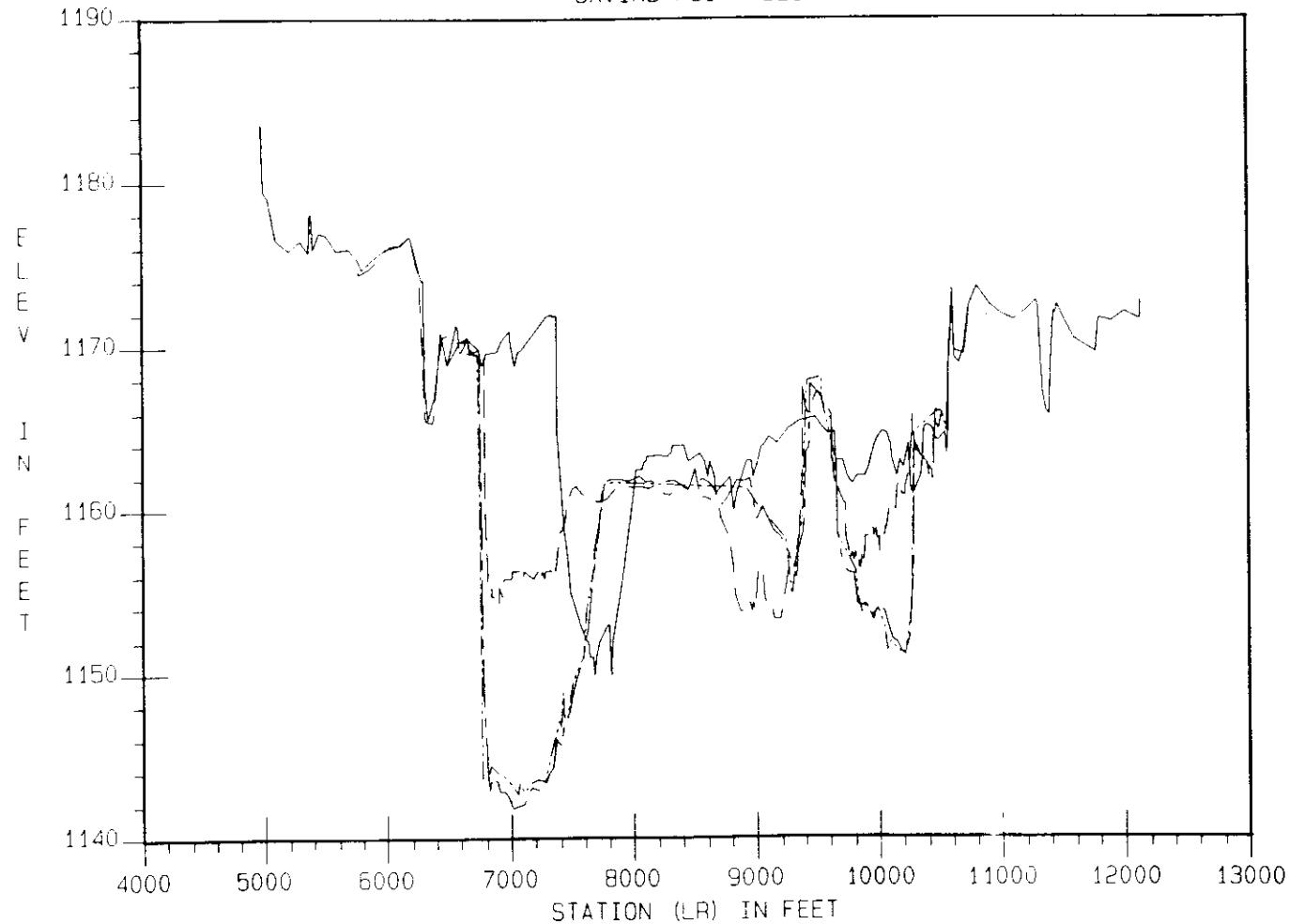


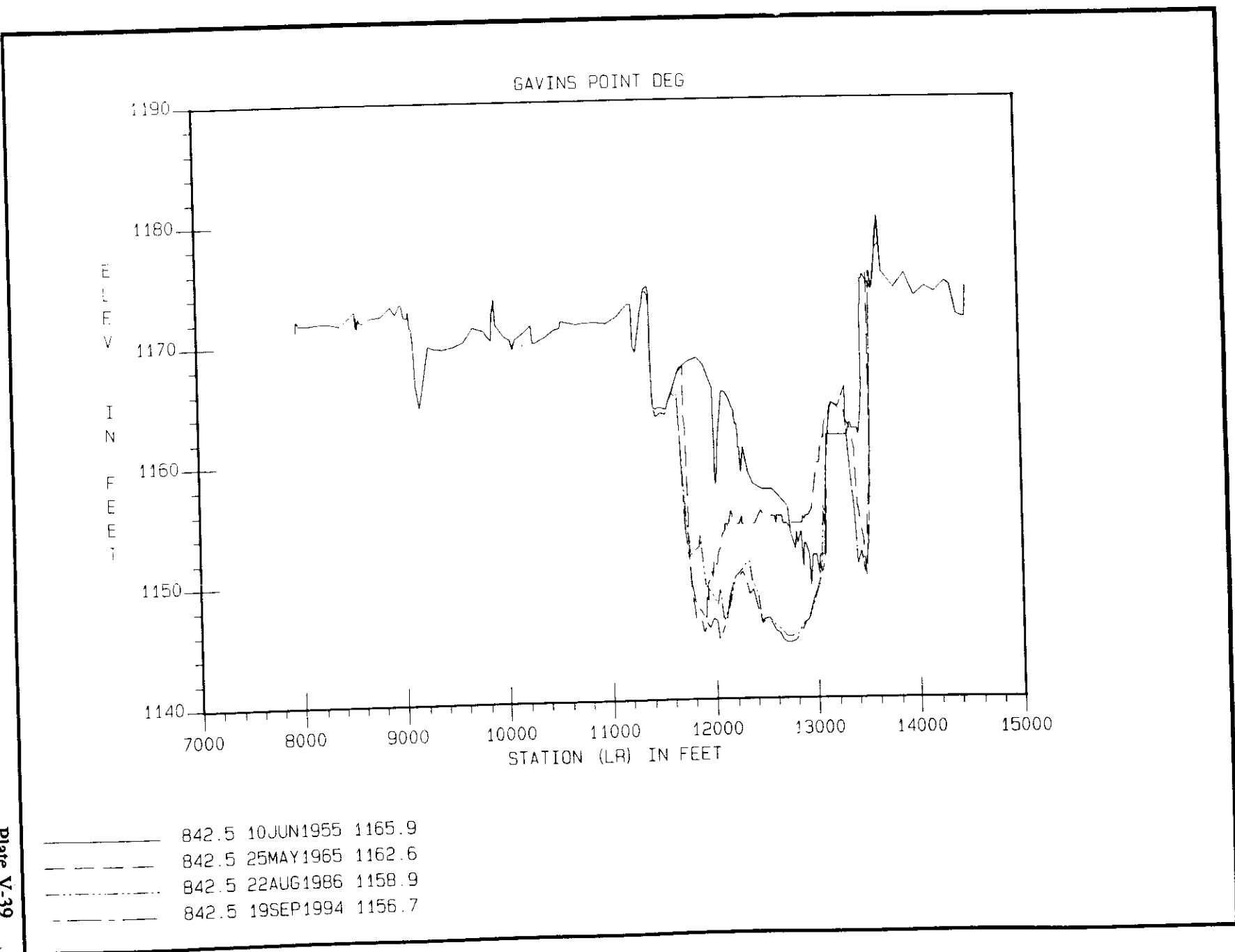






GAVINS POINT DEG





GAVINS POINT DEG

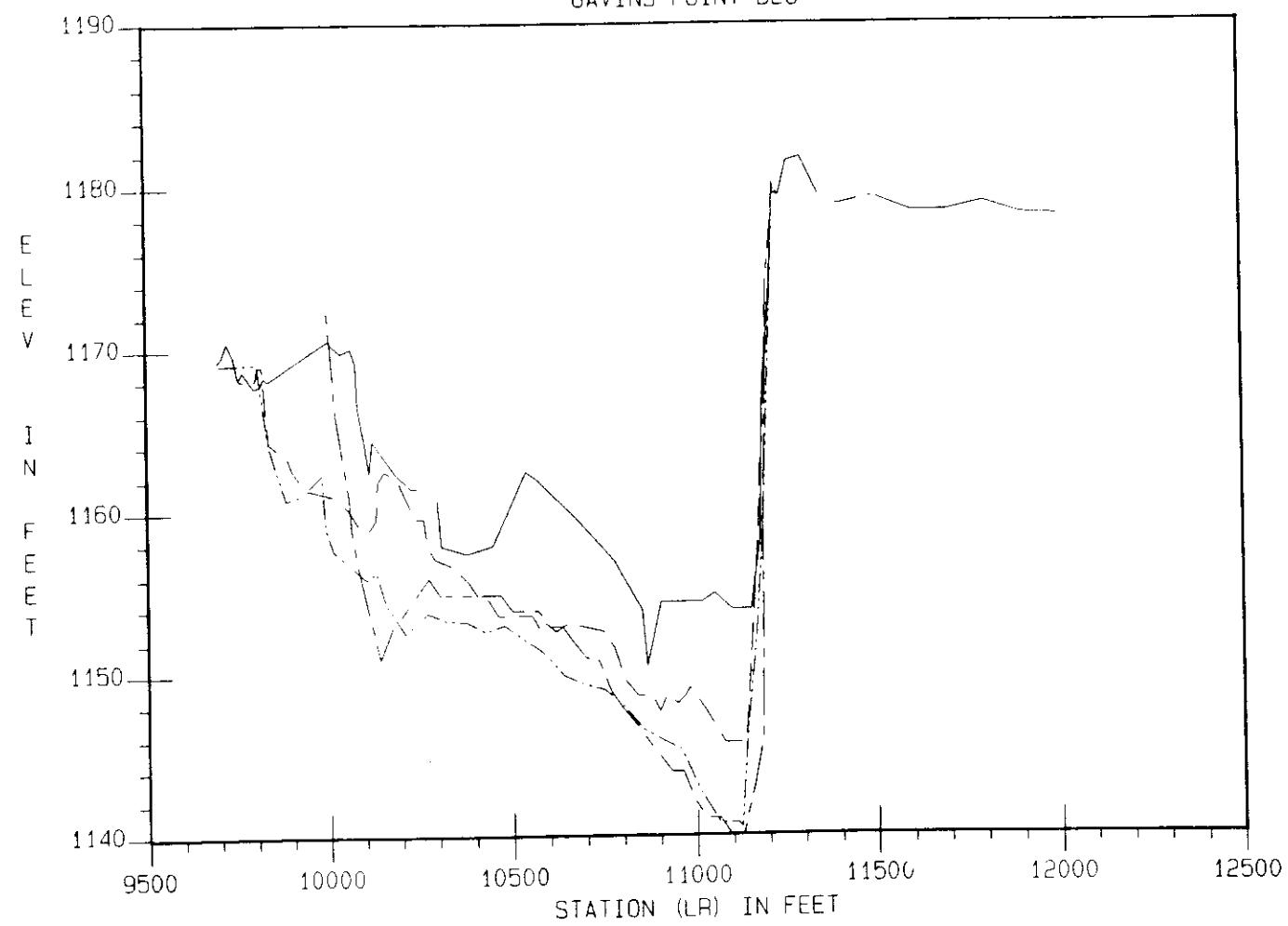


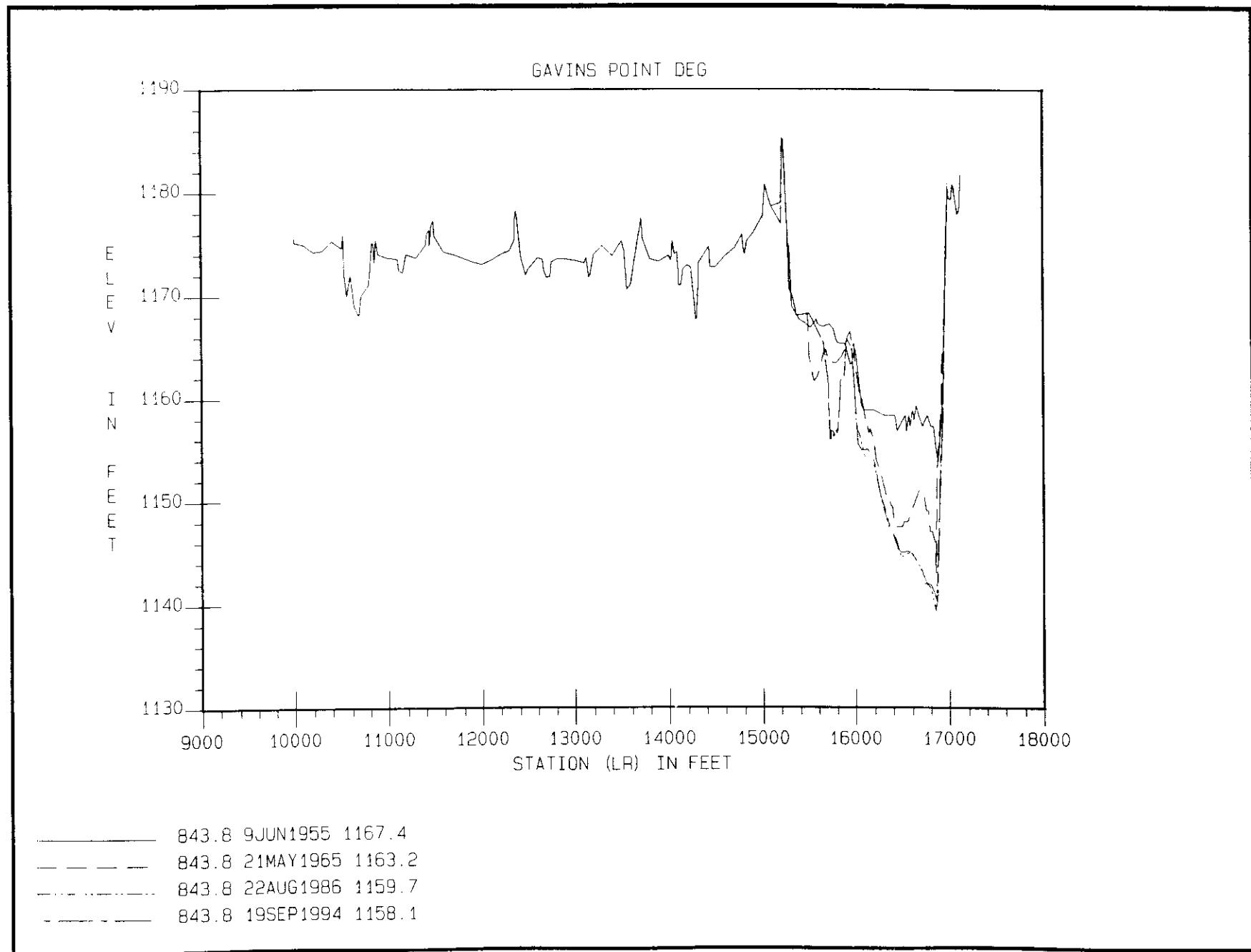
Plate V-40

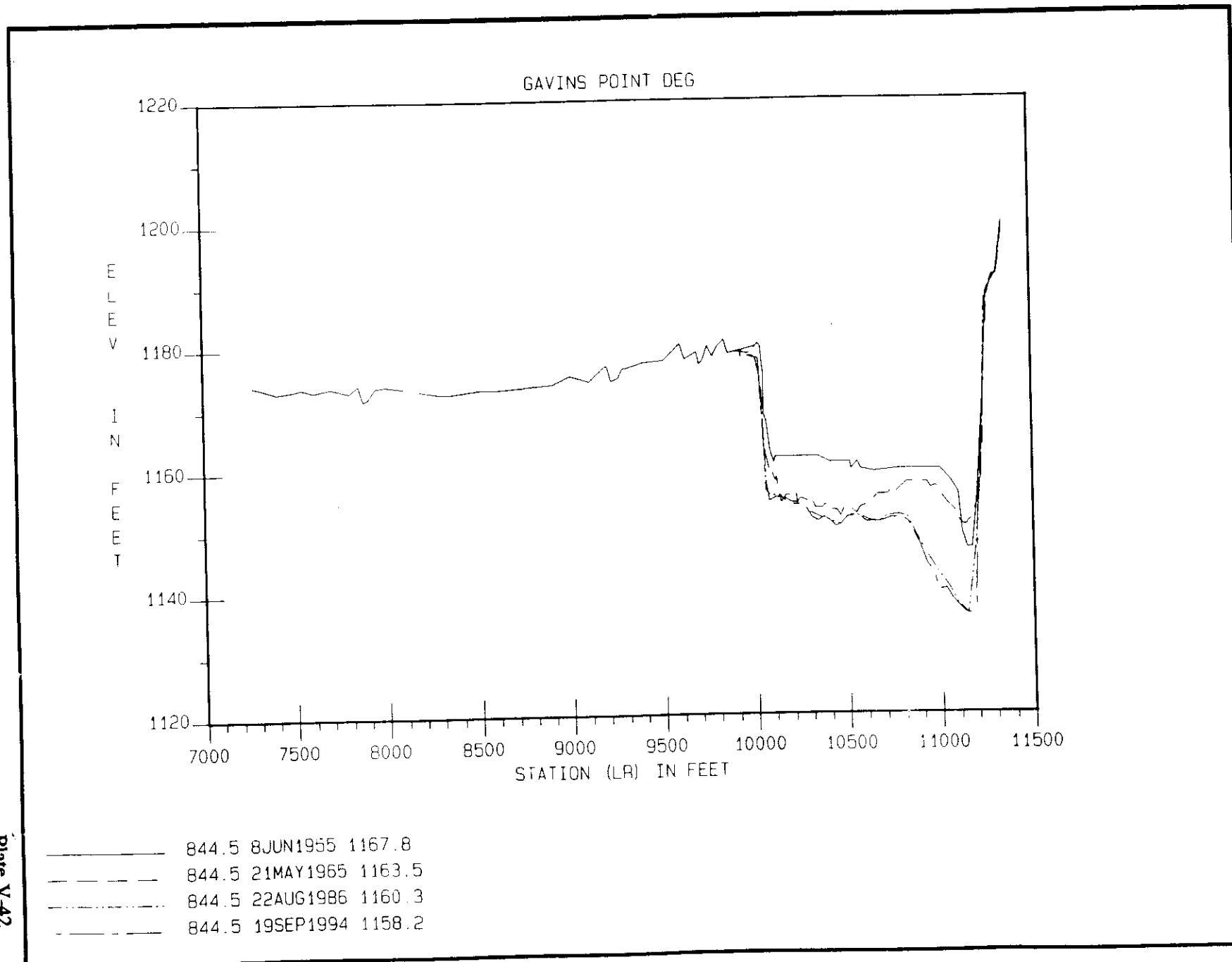
843.1 9JUN1955 1166.5

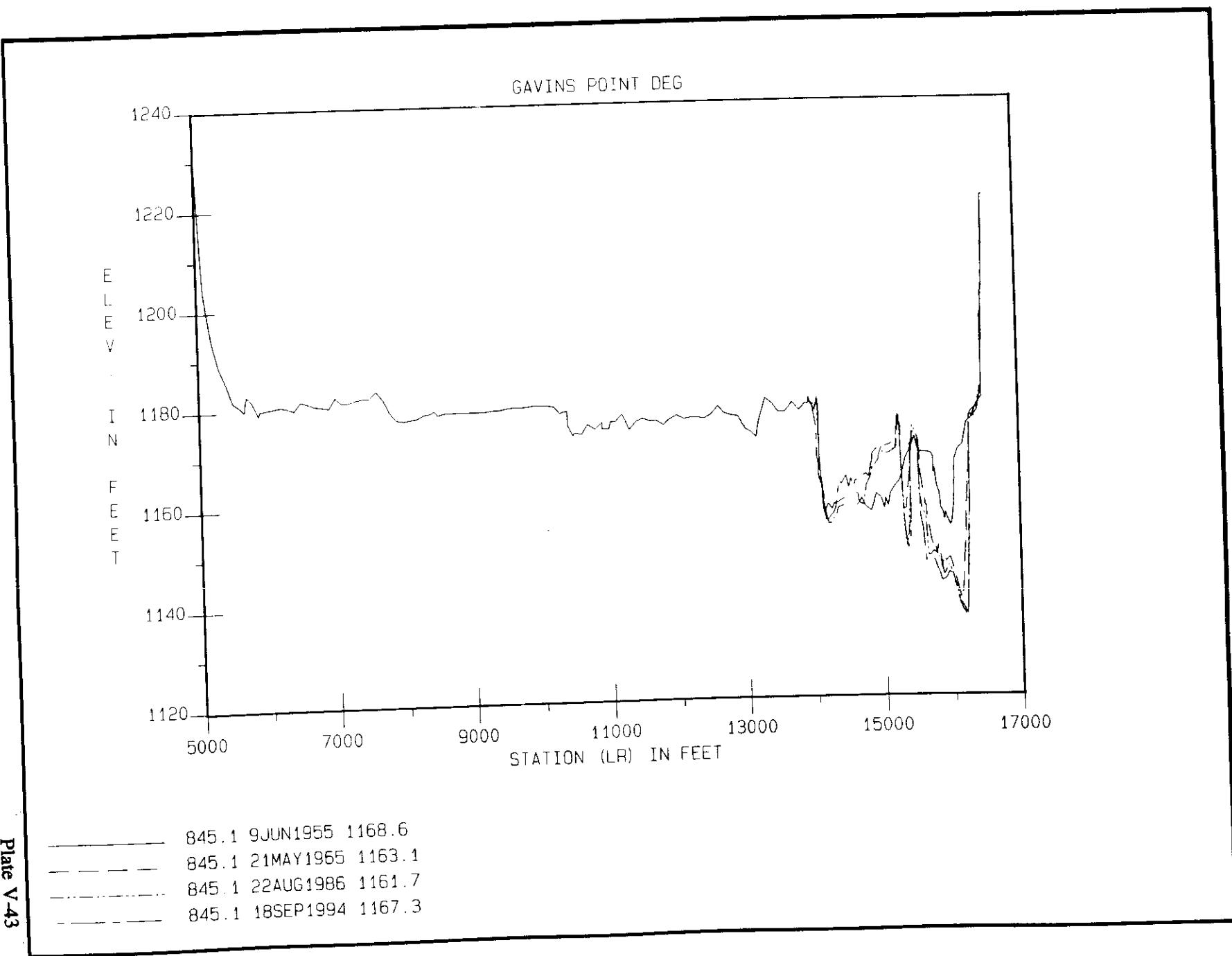
843.1 25MAY1965 1162.7

843.1 22AUG1986 1162.1

843.1 30SEP1994 1158.6 **New Line**







## CHAPTER VI - CHANNEL GEOMETRY

### DATA AVAILABLE

Water surface profiles for years 1956, 1965, 1986 and 1994 were used to develop Reference Plane Elevations and are the same water surface profiles which were adjusted to a common discharge. Channel cross-section and hydraulic elements data were obtained in those same years.

The evaluation of the channel geometry was based on an analysis of various hydraulic parameters described in the hydraulic elements tables produced by the Omaha District, Corps of Engineers. The Omaha District has a fortran program, SACHELM, that produces a set of tables showing various parameters. A brief description of SACHELM is described in the next paragraph. These tables present the hydraulic elements relative to elevation. The parameters available in the hydraulic elements tables are channel width (W) at a given elevation, channel cross sectional area (A) below a given elevation, mean depth (D) below a given elevation, and average bed elevation (E). The average bed elevation is referenced to a constant elevation plane set for each range. The thalweg elevation (T) which was taken to be the lowest elevation in the range cross section was also described in the tables. Hydraulic elements tables have been prepared for all available aggradation ranges at all available survey years.

SACHELM reads cross section data and computes cross section width, area, average depth, and average bed elevation, by elevation increments. In processing the data, the cross section width and area values are computed using successive pairs of x-y input points. Two successive x points are used to define an incremental width for which area is computed. This results in a vertical area slice with a width equal to the difference of the successive x points, and running from the bed elevations at that point to the specified maximum elevation. This process continues across the sedimentation range and a summation is made of the cross section width at each elevation increment and the total cross section area from bed to each elevation increment. Average depth for each elevation increment is computed by dividing area by width for that elevation. Average bed is the elevation minus the average depth for each elevation increment.

### REFERENCE PLANE ELEVATIONS

To analyze the channel geometry, two reference plane concepts were used; the total channel reference plane and the active channel reference plane. The total channel reference plane is used to provide a datum which approximately parallels the flow profile for the river, incorporates all areas of change within the cross sections over the period of record, and is fixed over the study period. In contrast, the active channel reference planes were established to reflect the average flow condition in each year of record (i.e. the adjusted water surface profile).

Total Channel. The total channel reference plane was established by matching the geometric characteristics of the channel cross sections with an approximation of a high water

surface profile. From the channel geometry, elevations were determined for each range cross section which represented the lower of the bank berms as a maximum and the upper level of channel changes as a minimum. The total channel reference plane was then set by fitting an approximation of a high water surface profile within the envelope formed by the boundaries. Table VI-1 shows the total channel reference elevation at each sediment rangeline location.

Active Channel. The active channel reference plane elevation used for each profile was the adjusted water surface elevation corresponding to the survey (profile) year. While this procedure results in a changing reference plane for each plotted profile, it is believed to offer the best representation of channel conditions/trends for average flow conditions. The discharge value for the reference plane developed is 30,000 cfs at Gavins Point Dam. The reference plane elevations used for each survey year are shown in Table VI-2. Figure VI-1 shows a typical cross section.

Figure VI-1  
Reference Plane  
Typical Cross-Section

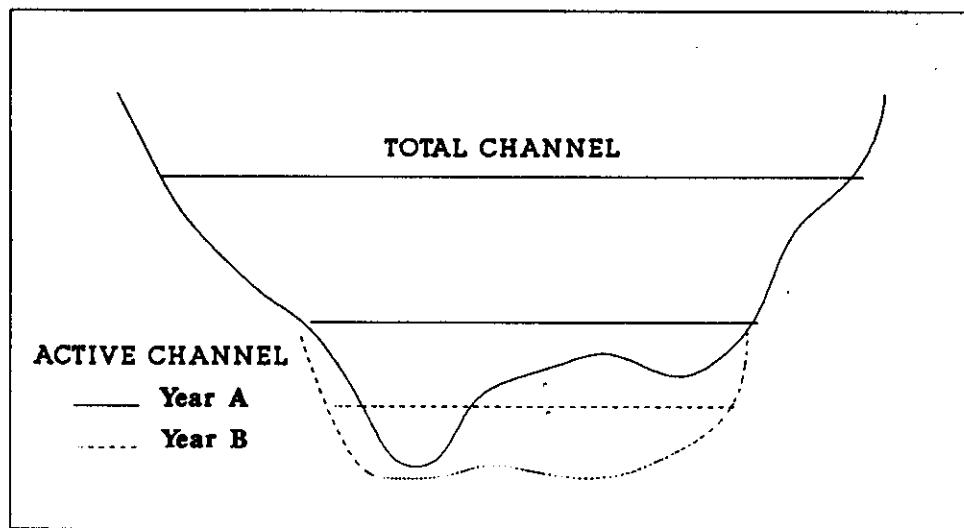


Table VI-1  
 Missouri River Below Gavins Point Dam  
 Reference Plane - Total Channel

Range Number

1941 RM	1960 RM	Reference Plane Elevation
783.6	753.18	1112.2
786.4	755.56	1115.0
788.8	758.24	1117.3
791.2	760.15	1119.7
793.9	762.77	1122.4
797.5	766.13	1125.9
801.4	768.41	1129.8
804.2	771.22	1132.6
806.3	773.36	1134.6
808.5	775.80	1136.8
810.2	776.70	1138.5
812.7	778.90	1141.0
814.7	780.92	1143.0
816.5	782.36	1144.7
817.7	783.61	1145.9
820.0	785.75	1148.2
821.1	786.73	1149.3
822.0	787.60	1150.2
823.0	788.90	1151.2
824.1	790.12	1152.2
825.2	791.24	1153.3
826.3	792.34	1154.4
827.3	793.60	1155.4
828.5	794.25	1156.6
829.4	795.13	1157.5
830.6	796.51	1158.7
831.7	797.50	1159.8
832.8	798.51	1160.8
834.5	799.81	1162.5
835.3	800.85	1163.3
836.1	801.93	1164.1
837.6	803.25	1165.6
839.1	804.28	1167.1
839.9	805.17	1167.9
840.4	805.72	1168.4
840.6	805.89	1168.6
841.0	806.16	1169.0
841.6	806.83	1169.5
842.5	807.75	1170.4
843.1	808.39	1171.0
843.8	809.00	1171.7
844.5	809.66	1172.4
845.1	810.15	1173.0

**Table VI-2**  
**Missouri River Below Gavins Point Dam**  
**Reference Plane - Active Channel**

Range Number		Reference Plane Elevation (Q=30,000 cfs)			
1941 RM	1960 RM	1956	1965	1986	1994
783.6	753.18	1104.4	1103.7	1097.9	1095.7
786.4	755.56	1107.0	1106.7	1101.6	1100.1
788.8	758.24	1109.9	1110.0	1104.6	1102.3
791.2	760.15	1111.9	1112.1	1106.3	1106.0
793.9	762.77	1114.6	1115.0	1108.8	1109.3
797.5	766.13	1118.0	1118.8	1113.0	1113.0
801.4	768.41	1120.4	1121.3	1115.8	1115.5
804.2	771.22	1123.9	1124.3	1119.2	1119.1
806.3	773.36	1126.5	1126.7	1121.8	1121.9
808.5	775.80	1129.5	1129.3	1124.8	1124.9
810.2	776.70	1130.6	1130.7	1126.0	1126.0
812.7	778.90	1133.3	1134.1	1129.1	1128.6
814.7	780.92	1135.8	1137.3	1131.9	1131.3
816.5	782.36	1137.6	1139.5	1133.8	1133.5
817.7	783.61	1138.9	1140.6	1134.7	1135.3
820.0	785.75	1141.3	1142.6	1138.4	1137.9
821.1	786.73	1142.4	1143.5	1139.4	1138.7
822.0	787.60	1143.3	1144.3	1140.3	1139.5
823.0	788.90	1144.8	1145.5	1141.6	1140.4
824.1	790.12	1146.1	1146.6	1142.8	1142.0
825.2	791.24	1147.3	1147.6	1144.0	1143.2
826.3	792.34	1148.5	1148.6	1145.2	1144.4
827.3	793.60	1149.8	1149.8	1146.5	1145.4
828.5	794.25	1151.5	1151.2	1148.1	1146.9
829.4	795.13	1151.6	1151.3	1148.2	1147.0
830.6	796.51	1153.0	1152.5	1149.4	1148.3
831.7	797.50	1154.2	1153.6	1150.1	1148.9
832.8	798.51	1155.4	1154.6	1150.9	1149.9
834.5	799.81	1156.9	1155.9	1151.8	1151.3
835.3	800.85	1158.1	1157.0	1152.6	1152.0
836.1	801.93	1159.4	1158.2	1153.6	1152.6
837.6	803.25	1161.0	1159.7	1154.8	1153.4
839.1	804.28	1161.9	1160.4	1155.4	1154.0
839.9	805.17	1162.7	1161.0	1155.9	1154.6
840.4	805.72	1163.2	1161.3	1156.2	1155.0
840.6	805.89	1163.4	1161.4	1156.3	1155.1
841.0	806.16	1163.6	1161.6	1156.5	1155.3
841.6	806.83	1164.2	1162.1	1156.9	1155.8
842.5	807.75	1165.0	1162.7	1157.5	1156.4
843.1	808.39	1165.6	1163.1	1157.9	1156.9
843.8	809.00	1166.2	1163.5	1159.3	1157.5
844.5	809.66	1166.7	1163.9	1158.9	1158.2
845.1	810.15	1167.0	1164.2	1159.1	1158.4

## HYDRAULIC PARAMETERS

Hydraulic parameters analyzed for this reach are channel width, thalweg, average bed, and cross-section area. The active channel reference plane is based on a 30,000 cfs discharge at Gavins Point Dam.

Top Width. Channel width profiles for each year were determined from hydraulic elements tables using the corresponding total and active channel reference plane elevations.

Cross-Section Area. Channel cross-section area values represent the cross-sectional area, from hydraulic elements tables, below the corresponding total and active channel elevations.

Cross-Section Average Bed Elevation. The data for the average bed profiles was obtained from hydraulic elements tables. These tables were produced by a computer program that reads cross-section data and computes cross-section width, area, average depth, and average bed elevations by elevation increments. In processing the data, the cross-section width and area values are computed using successive pairs of X-Y input points. Two successive X points are used to define an incremental width for which area is computed. This results in a vertical area slice with a width equal to the difference of the successive X points, and running from the bed elevations at that point to the specified maximum elevation. This process continues across the sedimentation rangeline and a summation is made of the cross-section width at each elevation increment and the total cross-section area from bed to each elevation increment. Average depth for each elevation increment is computed by dividing area by width for that elevation. Average bed is the elevation minus the average depth for each elevation increment.

This elevation was obtained by subtracting the average cross-section depth from the reference plane elevation to provide a hydraulic bed elevation which correlates with the average water surface profile.

Cross-Section Thalweg Elevation. The thalweg elevation is the lowest observed elevation in the range cross section for any given survey.

## TREND EVALUATIONS

Cross-Section Top Width. The longitudinal changes in cross-section width are shown on Plates VI-1 and VI-2. The total channel width changes little at most locations but does show a slight increase with time. Irregularities occur at RM 768, RM 789 and RM 794. For a number of reasons, range survey monuments are vandalized, destroyed or lost and new lines must be surveyed. The new line is usually close to the old one if only one monument is gone. If both monuments are lost, it is almost impossible to place the line in the exact location. Therefore, at certain locations the 1994 values appear irregular but this does not indicate an abnormal trend.

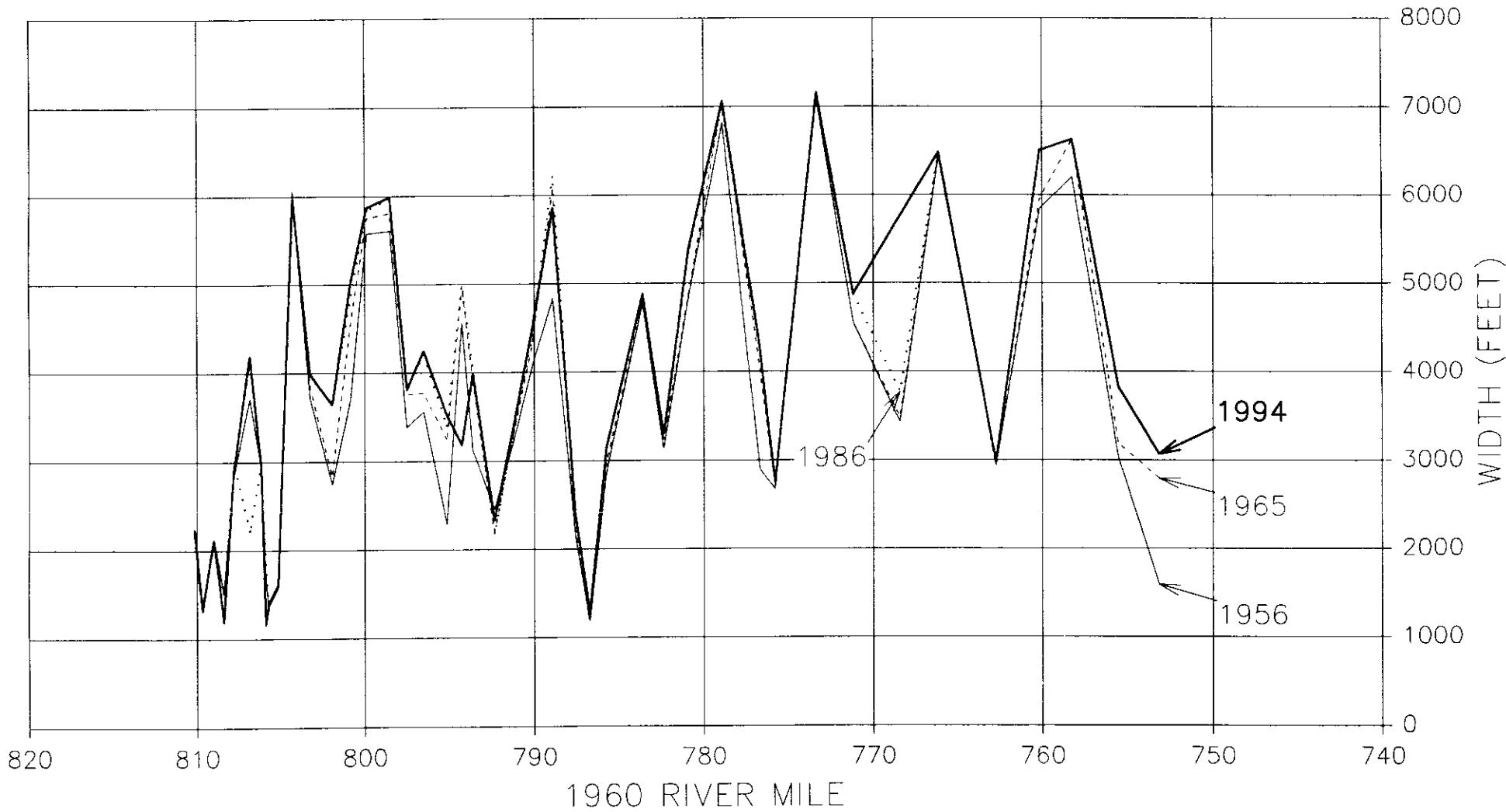
The active channel width plot shows no discernible trend. This would be expected because the active channel reference elevation corresponds to a discharge that is within the channel banks.

Cross-Section Area. The time variations of cross-section area versus river mile for the entire study reach are shown on Plates VI-3 and VI-4. The total channel plot shows an increase in cross-sectional area for all years. The change between 1986 and 1994 is very small. Again, the irregularities at RM 768, RM 773, RM 794, RM 801 and RM 808 are due to new survey lines in 1994. The active channel plot indicates no discernible trend, as would be expected.

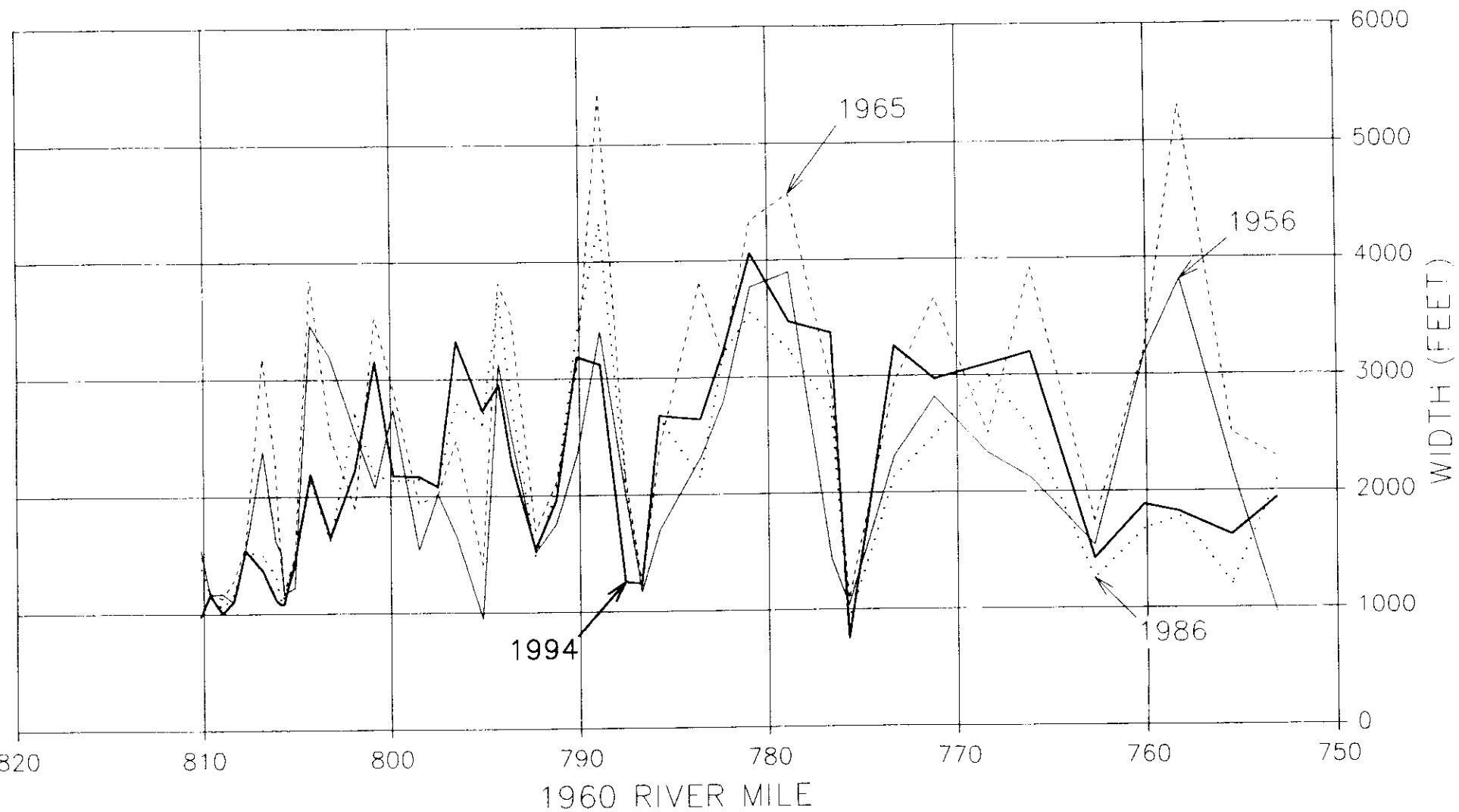
Average Bed Elevation. Plates VI-5 and VI-6 represent the average bed elevations for 1956, 1965, 1986, and 1994. In general, the channel bed elevation degraded progressively with time for the entire study reach. RM 768 shows the 1986 survey below the 1994 survey. This is due to a new survey line in 1994. At RM 787 it appears that short term aggradation occurred in recent years.

Thalweg. Plate VI-7 shows the thalweg profile plots. From RM 810 to RM 800 the thalweg has experienced a noticeable decrease in elevation (about 10 feet). From RM 800 downstream to RM 775, the thalweg is generally lower than in previous years. Between RM 775 and RM 770, the thalweg experiences large fluctuations. Downstream of RM 770, the thalweg fluctuates but still shows a general decrease. These fluctuations could be caused by bluff contact, bed armouring, etc. A more in-depth study, including site work, would be required to analyze individual reaches.

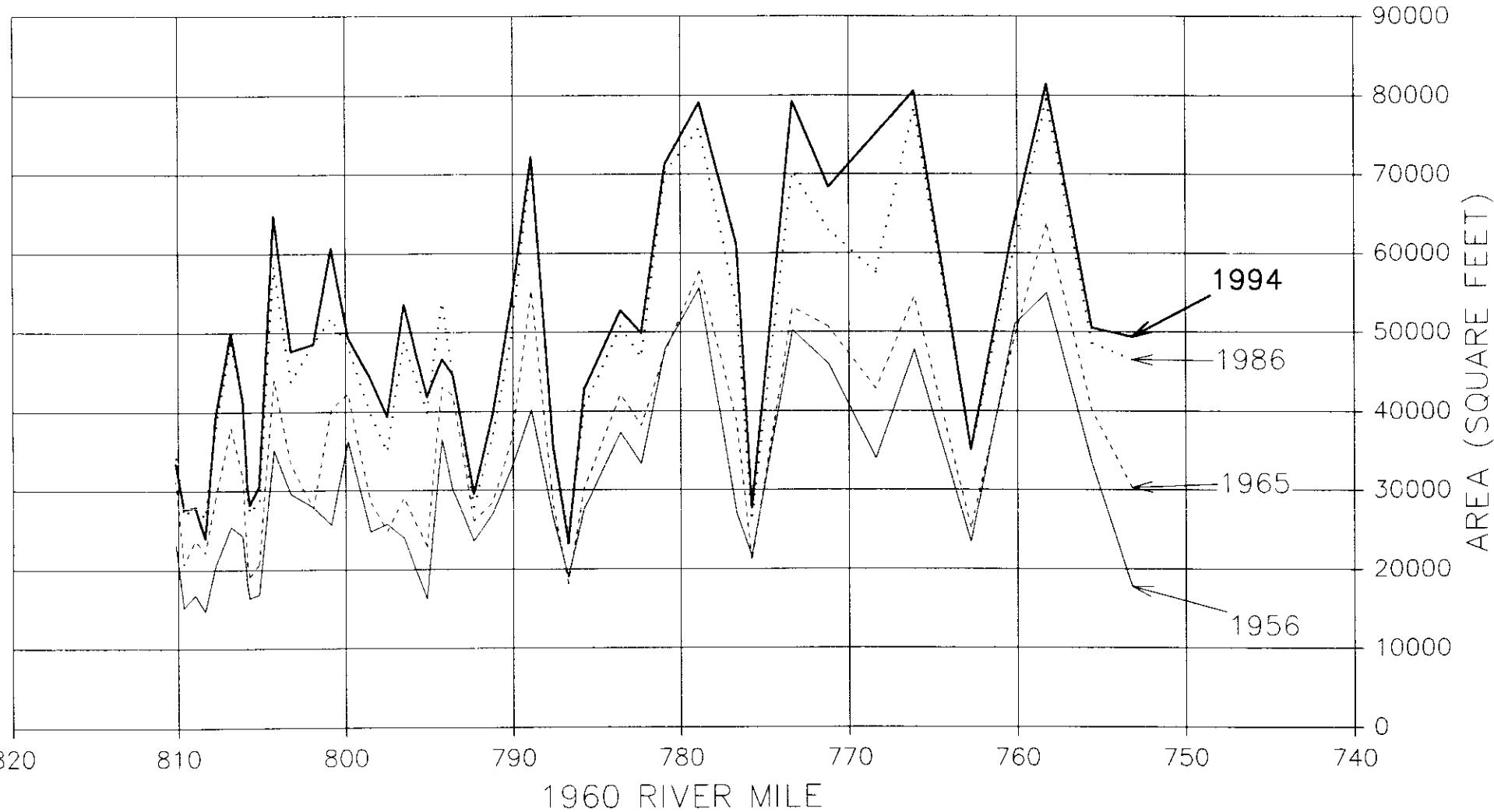
## GAVINS POINT DEGRADATION REACH TOTAL CHANNEL WIDTH PROFILE



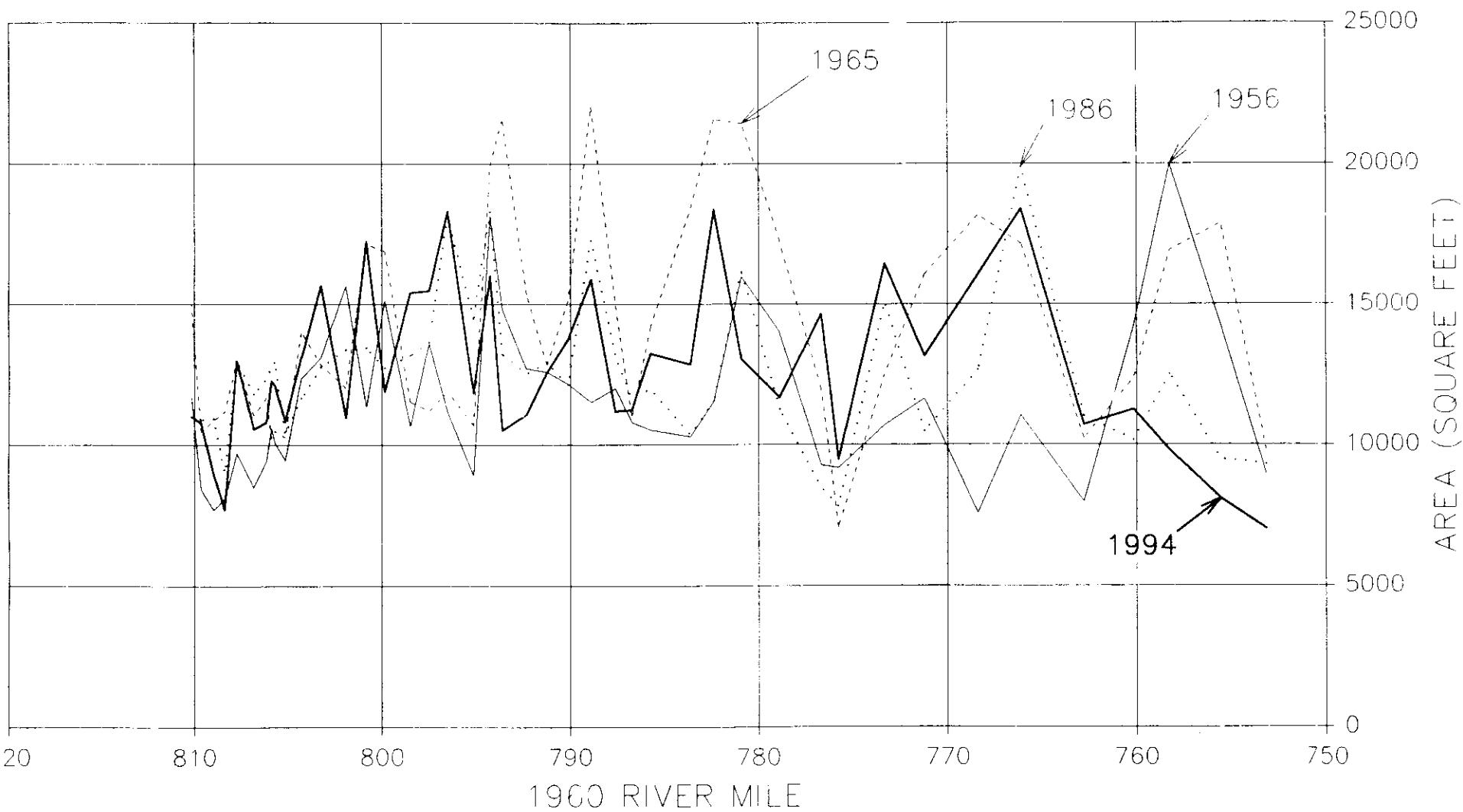
## GAVINS POINT DEGRADATION REACH ACTIVE CHANNEL WIDTH PROFILE



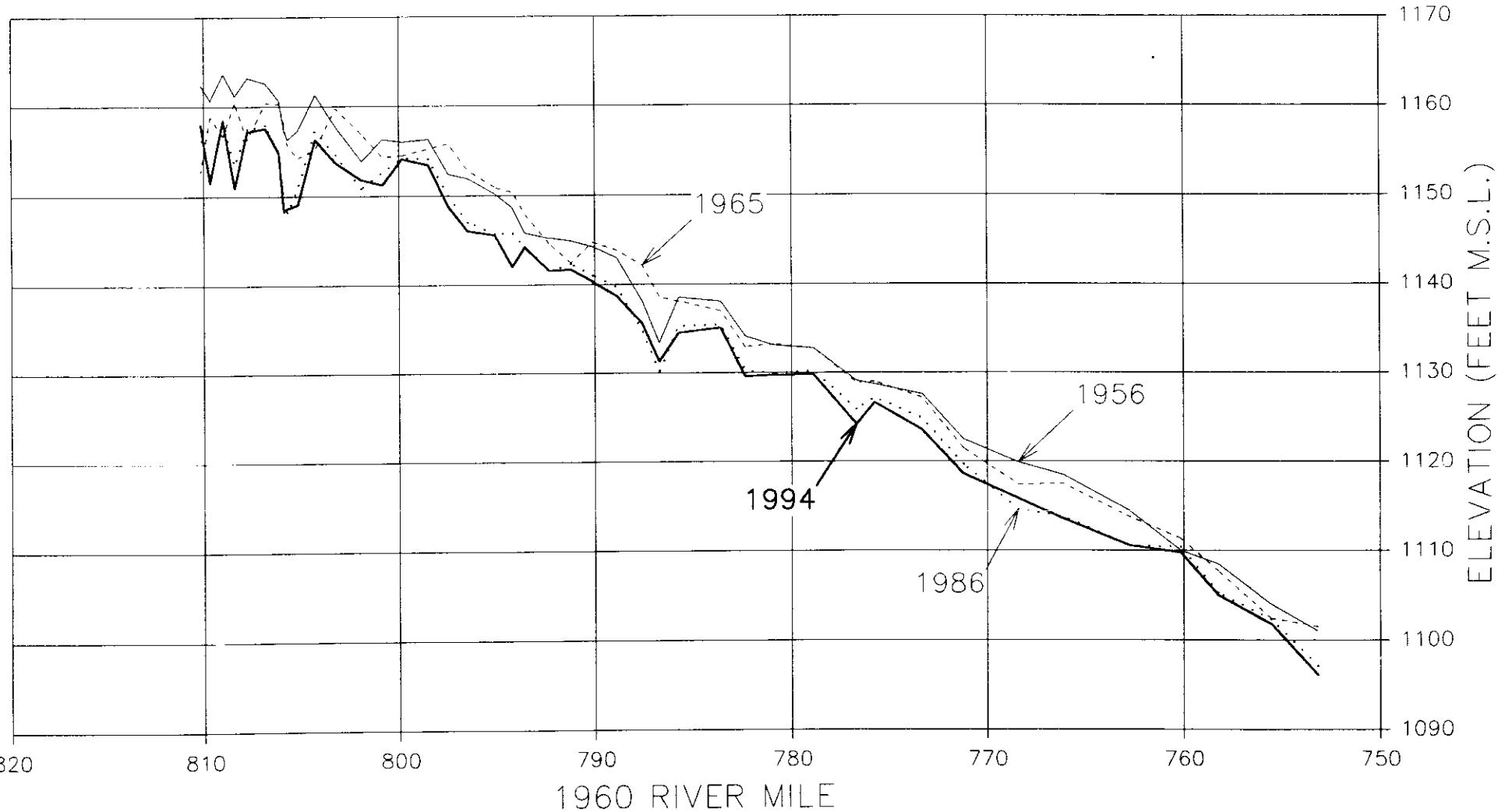
GAVINS POINT DEGRADATION REACH  
TOTAL CHANNEL CROSS-SECTION AREA PROFILE



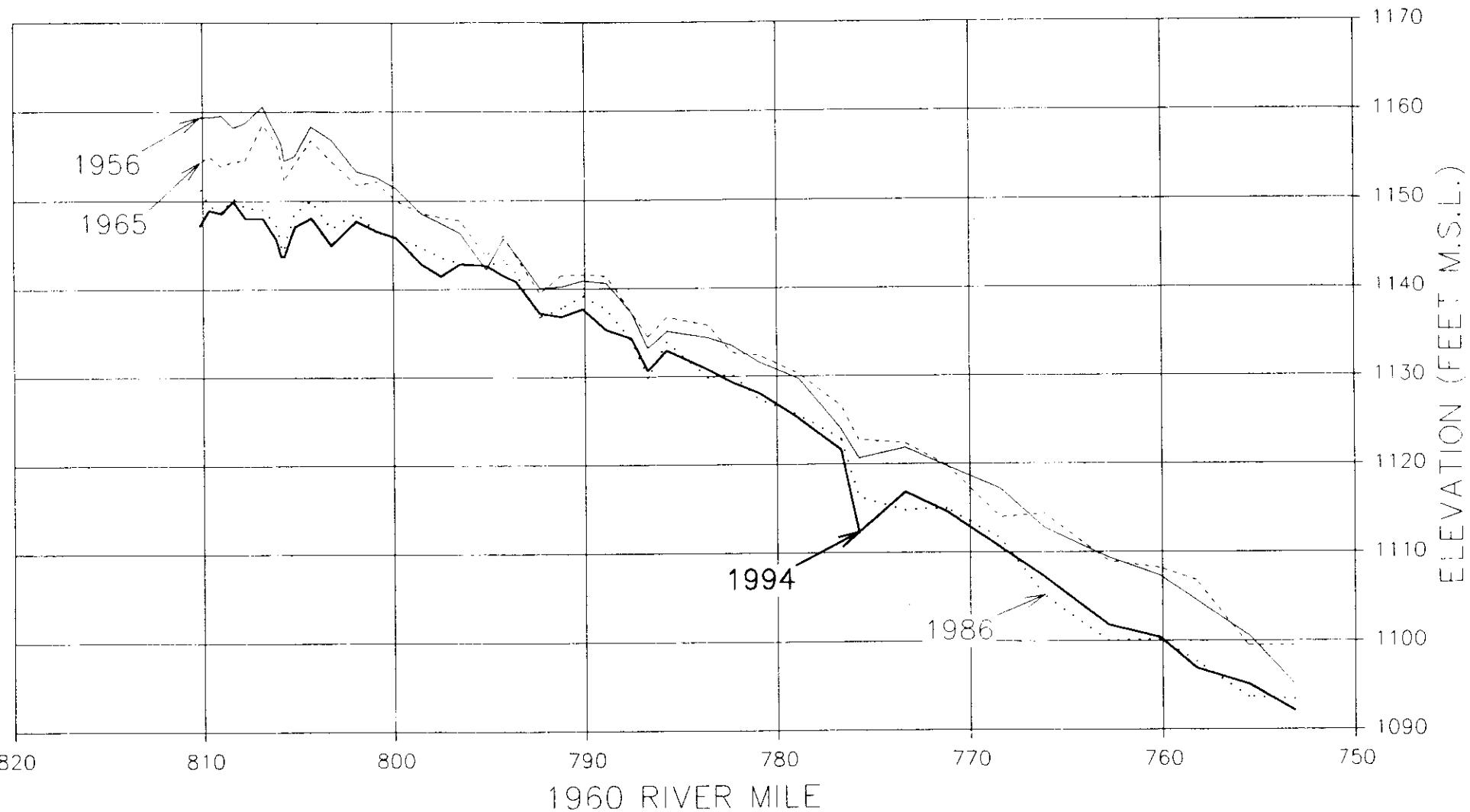
GAVINS POINT DEGRADATION REACH  
ACTIVE CHANNEL CROSS-SECTION AREA PROFILE



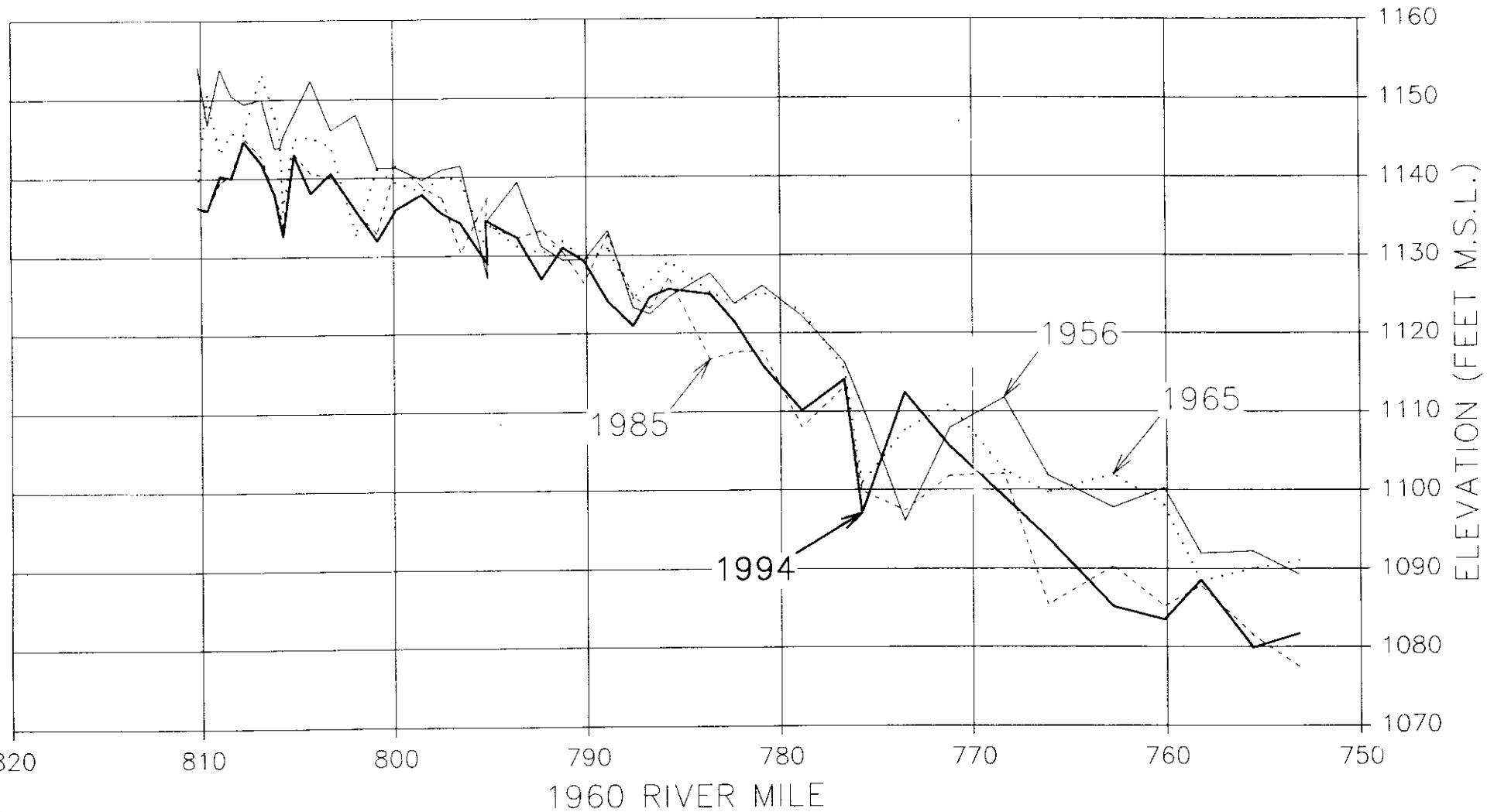
GAVINS POINT DEGRADATION REACH  
TOTAL CHANNEL AVERAGE BED PROFILE



GAVINS POINT DEGRADATION REACH  
ACTIVE CHANNEL AVERAGE BED PROFILE



GAVINS POINT DEGRADATION REACH  
THALWEG PROFILE

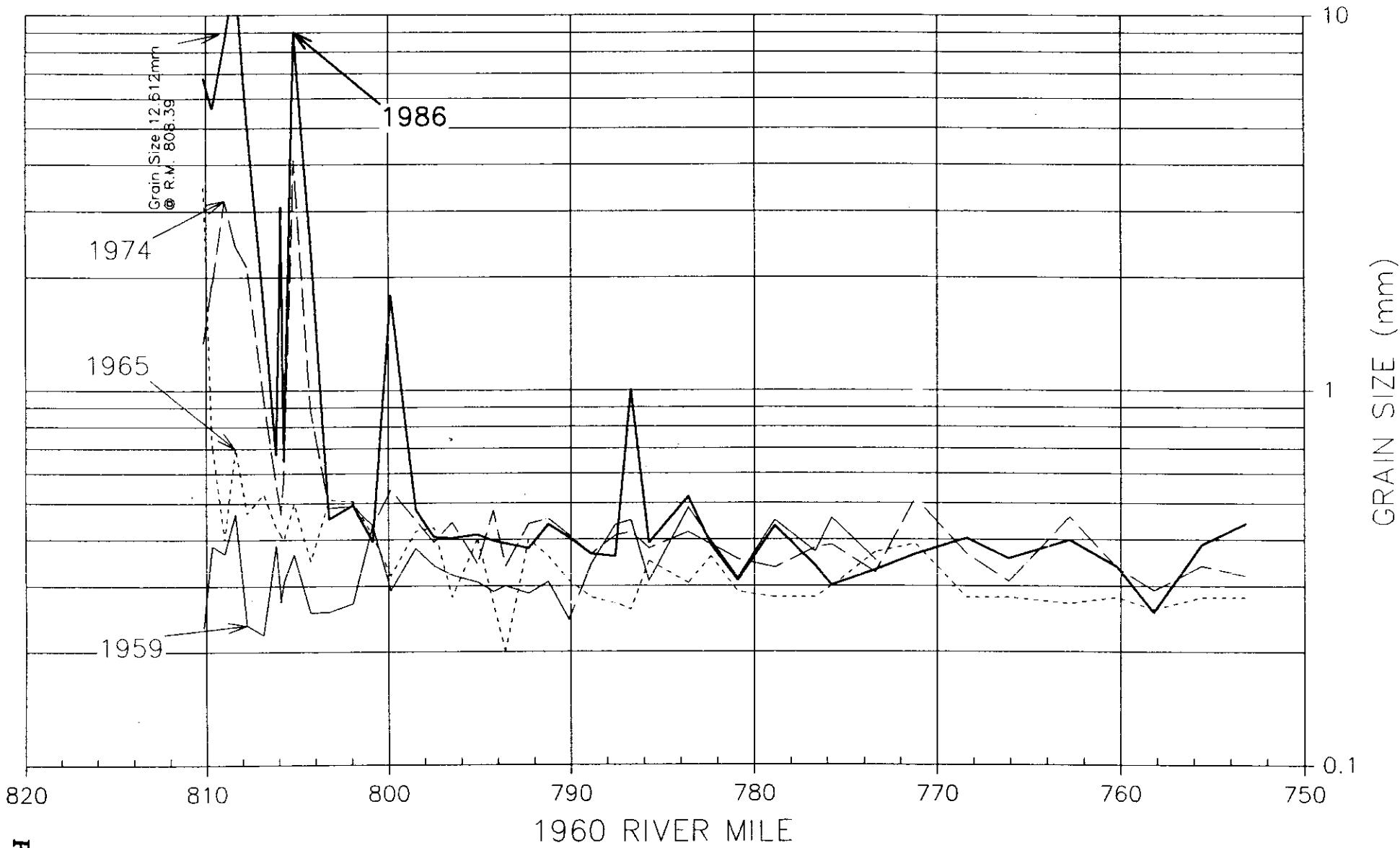


## CHAPTER VII - CHANNEL BED MATERIAL OBSERVATION DATA

Most typically, between four and eight bed surface samples were taken across the section in any survey. These were collected at the same locations as the rangeline data. Each of these samples was graded by sieve analysis, and, from the individual sample grading data, a composite sediment size was determined for a specific percent passing value. From these, grain size data tabulations of the  $D_{50}$ , (50 percent coarser) were made and plotted for each cross section. In general, samples were obtained between May and September of any given year. It should be noted that these bed samples do not necessarily represent the bed sediment loads for the actual river, but rather are more likely indicative of the most recently deposited or exposed sediments at the sampling location.

Plate VII-1 shows the  $D_{50}$  bed material grain size distribution. Immediately downstream from Gavins Point Dam to about RM 795, a significant progressive trend of coarsening of the bed material with time is observed. As an example, the median bed material size in this reach increased from about 0.4 mm to about 10 mm at certain locations. Downstream from RM 795, no historical or spatial trends can be determined. In this same reach the bed material is coarsest immediately downstream of the dam, generally becoming less coarse with distance downstream.

GAVINS POINT DEGRADATION REACH  
50% COARSER GRAIN SIZE DISTRIBUTION



## CHAPTER VIII - BANK EROSION RATES

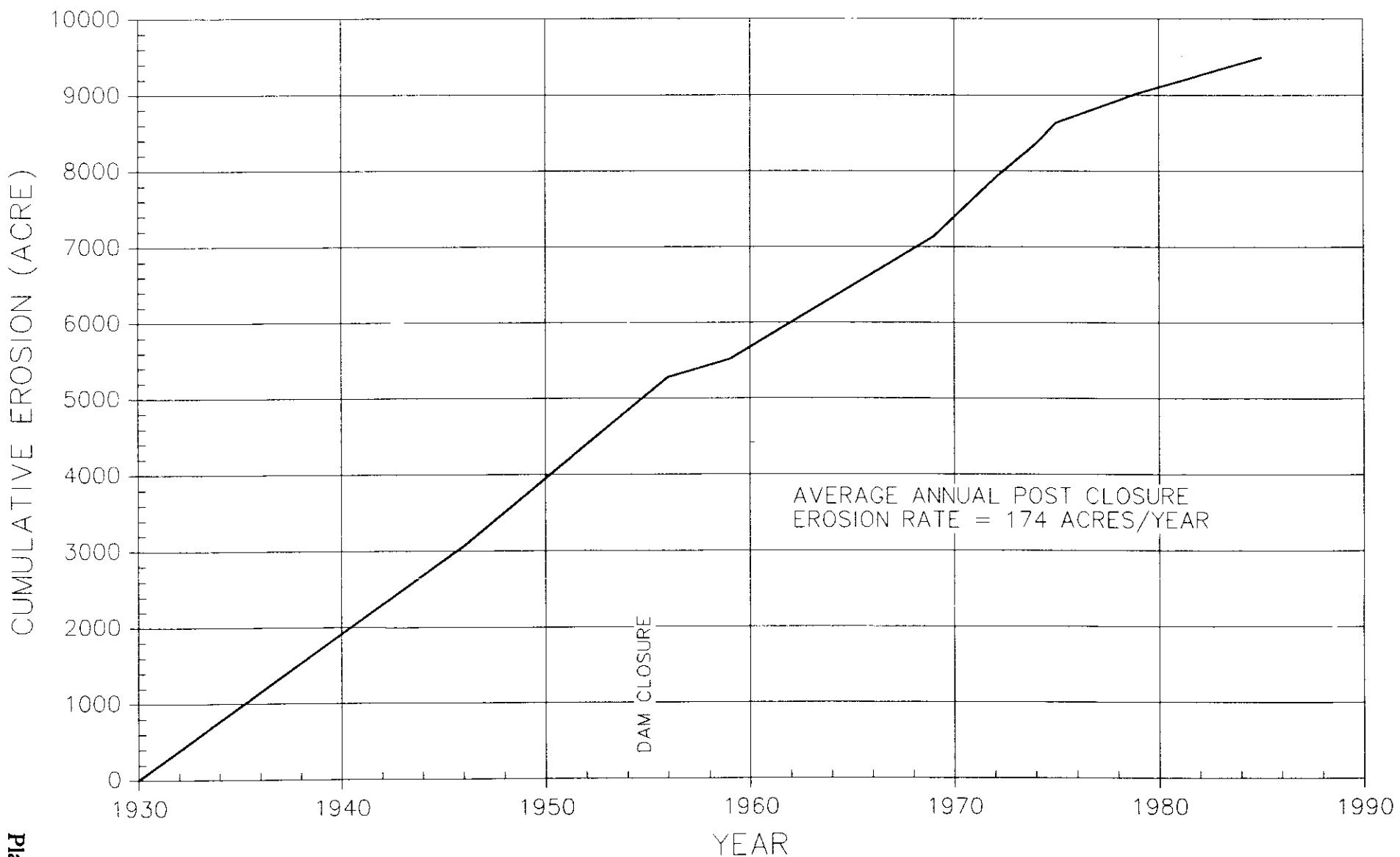
### DATA AVAILABLE

Plate VIII-1 shows the cumulative erosion with time. The average annual rate of erosion for the entire study reach is about 174 acres/year as shown on Table VIII-1. In general, the bank erosion rate is slightly greater for the period before closure of the dam (about 203 acres/year). Nine erosion control projects have been constructed by the Federal Government. Three additional projects were constructed by local entities. This probably contributes to the decreased rate of erosion but is not documented by any studies.

Table IX  
Missouri River Below Gavins Point Dam  
Bank Erosion Rates

Years	Acres Lost	Acres Lost/Year	Cumulative Acres Lost	Cumulative Acres Lost/Year
Pre-Dam				
1930-1946	3062.4	191.4	3062.4	191.4
1946-1956	2213.6	221.4	5276.0	202.9
Post-Dam				
1956-1959	237.8	79.3	5513.8	190.1
1959-1969	1661.9	166.2	7175.7	184.0
1969-1972	783.5	261.2	7959.2	189.5
1972-1974	451.4	225.7	8410.6	200.3
1974-1975	277.1	277.1	8687.7	193.1
1975-1979	404.3	101.1	9092.0	185.6
1979-1985	474.3	79.1	9566.3	173.9

GAVINS POINT DEGRADATION REACH  
CUMULATIVE EROSION (R.M. 753.2-804.9)



## CHAPTER IX - SUMMARY

The study reach encompasses the 58-mile uncontrolled reach of the Missouri River between Gavins Point Dam and Ponca City, Nebraska. Data collected in 1956, 1965, 1986 and 1994 are presented in some detail.

Water surface profile plots indicate a general decrease in elevation throughout the reach. Gaging stations located at Gayville, Maskell, and Ponca also show trends that decrease over time.

Hydraulic parameters analyzed for this reach include channel width, thalweg, average bed, and cross-section area. The active channel reference plane is based on a 30,000 cfs discharge at Gavins Point Dam. The total channel plots show an increase in both cross-sectional area and top width. Neither active channel plots indicate a clear trend. The average bed profiles for both the total and active channel degraded progressively with time for the entire reach. The thalweg profile shows a noticeable decrease (about 10 feet) on the upstream end. Downstream of RM 800, the decrease is smaller with large fluctuations between RM 770 and 775.

Immediately downstream of the dam, a significant progressive trend of bed material coarsening with time is observed. Downstream of RM 795, no trend can be determined.

The average bank erosion rate is 174 acres per year. This is slightly less than the pre-dam rate.

Overall, the trends exhibited by the data collected for this reach are typical for a river reach located immediately downstream of a dam.